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EDITORIAL.

Rubber Statistics. Since the review of statistics relating to rubber in the Federated Malay States by Mr. J. Gordon-Carrie was published in the January issue of this Journal, a considerable amount of further work has been done by the Statistical Division of the Department of Agriculture, Straits Settlements and Federated Malay States in collaboration with the Department of Statistics, Straits Settlements and Federated Malay States and the Governments of the Unfederated Malay States; this is being embodied in a new booklet of Rubber Statistics for Malaya which will be issued in the near future. It is proposed to publish most of the tables in an early issue of this Journal, as now that it has been decided that no Government support can be given to any restriction scheme, up-to-date figures of areas planted and of proven yields cannot but be of value and interest to the industry. Two of the tables which will be included in the new booklet are published in this number of the *Malayan Agricultural Journal*. It will be seen that they give details of the areas tapped and the yields obtained during the year 1929 on all estates of 100 acres or over in area in the Federated Malay States and the Straits Settlements.

The Tables show that the average yield of rubber per acre in 1929 were slightly over 485 lbs. in the Federated Malay States and over 417 lbs. in the Straits Settlements. These yields are in both cases considerably higher than those obtained in 1928.

The average area rested during 1929 was less than that rested in 1928 and the number of days upon which tapping took place was considerably in excess of that recorded in 1928.

It is interesting to compare the yields in the Federated Malay States and the Dindings with those for the remainder of the Colony. The recorded yields for the past three years all show much the same comparative results. It is more than probable that this lower productivity of the rubber estates in the older parts of the Colony is due to the fact that many such estates were opened up on land previously planted with sugar cane or tapioca.

During the year 1929, the planted area in the Federated Malay States was increased by 24,125 acres and that in the Colony by almost 2,000 acres. These figures, however, are very small as compared with the area of new planting in the State of Johore; which is for 1929 estimated to be over 125,000 acres.

The yield per acre of the Federated Malay States small holdings still continues at the high level indicated in the charts which were published in the January issue of this Journal. In fact, the monthly figures, so far published in the *Malayan Agricultural Journal,* for 1930 are even higher than those for the corresponding months of the previous year. When it is remembered that the average area of an F.M.S. small holding is not more than two and a half acres and that a large proportion of small-holders have no other source of income than that gained by the sale of their rubber, it is easy to understand that, almost without exception, the small-holders have been compelled by the low price of rubber to press for the production of every possible pound of rubber from their holdings. While some falling off in the yields of the small holdings may with certitude be expected at a not distant date it would be a mistake to expect this falling off in yield to make much difference to the production of Malaya for some time yet to come. It seems highly probable that sheer economic necessity may compel the small-holders to continue to produce their rubber even if the price should fall considerably below the present low levels.

The latest information from the Netherlands East Indies indicates that many of the owners of the so-called "Native (Rubber) Gardens" have ceased to tap their rubber trees; but, in contrast to the small-holders of Malaya, most of the Sumatran owners of small rubber holdings are also producers of padi, fruit, vegetables and other crops. If the present slump results in a substantial increase in the foodstuff production in Malaya, the basic economic position of Malaya's small-holders will be very appreciably improved.

The monthly returns of statistics relating to rubber and to padi now regularly published in this Journal should enable all those interested to keep themselves informed as to the latest available information relating to the production and stocks of rubber as well as to watch the official figures of areas planted with padi.

Cover Crops and Soil Moisture. Since the general adoption of the system of cover crops in connection with permanent crops has become an accepted estate practice, the question of the effect of such covers on soil moisture has been a much debated question. The contribution in this number of an article by Mr. W. N. C. Belgrave is, we believe, the first account in this country of scientific investigations from which a definite conclusion can be made. The conclusion drawn by the Author that "no fear need be entertained of harmful effects of covers on the score of reduction of soil moisture content, even on young crops" should finally dispel the fears of those who were doubtful on this point.

Coffee. In view of the deflated prices for coffee, the present may appear to many as inopportune for recommending the further extension of the area under this crop in Malaya. During the past few years, this Department has frequently pointed out that the imports of large quantities of coffee for consumption in Malaya would justify an extension of

the area under this crop, and in spite of the present set-back of the coffee market in common with most other agricultural products, it would appear that the price of coffee has reasonable prospects of a satisfactory recovery.

The import and export figures of coffee into Malaya in 1929 are typical of those for some years past. In 1929, the total imports of raw coffee into Malaya were 5,984 tons while exports for the same period were 2,433 tons. Local consumption therefore accounted for 3,551 tons. According to the same source of information, the declared value of this coffee consumed locally was $2,383,817. In addition, the consumption of coffee imported in tins amounted to 317 tons, valued at $760,622. It is seen therefore that Malaya imports annually for local consumption about 4,000 tons of coffee valued at over $3,000,000. This weight of coffee represents the crop of about 15,000 acres.

The present area under coffee in Malaya is estimated at 13,000 acres, the produce of which finds its way mainly to the Singapore market and is either consumed locally or is included in the export figures referred to above. The conclusion therefore is that there is scope for 28,000 acres of coffee in Malaya to satisfy local consumption of which 13,000 acres already exists. If this extra area was in full bearing, there would be a saving to the country of $3,000,000.

In view of these facts and the increasing interest evinced locally in the cultivation of coffee, the inclusion in this number of an article, by Messrs. Bunting and Milsum, on the cultivation of coffee will be helpful to those who wish further to investigate the local possibilities of this crop.

The Oil Palm Industry. The plantation oil palm industry in Malaya registers a further development in the opening of a new factory in Johore. The point of interest in this event is that the machinery is the first in Malaya erected for the expression of the oil from the fruit by means of hydraulic presses. Hitherto, the Sumatran factories alone had confined themselves entirely to this method of extraction, while the Malayan factories, without exception, were equipped with machinery for the extraction of oil by the centrifuge method. We are not concerned at this moment with a discussion of the relative merits of the two systems—this question has been adequately ventilated in this Journal and in the Dutch publications—but wish to place before our readers in this number data concerning this new development of the industry in Malaya.

CULTIVATION OF COFFEE IN MALAYA

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Introductory.

Coffee cultivation occupies a position of minor importance in the agriculture of Malaya. The official returns of the coffee trade of Malaya for the period 1925—1929, show that the excess of imports over exports averages approximately 58,500 piculs (3,500 tons) of coffee beans valued at $2,390,000 (Straits currency) per annum. Against this the returns of planted areas under cultivation in Malaya show a total of some 13,000 acres under coffee at the present time. It is probable that most of this coffee is interplanted with some permanent crop.

Forty years ago, however, Liberian coffee was the principal plantation crop in Malaya. These areas were cut out and the land planted with rubber about 1900.

In the Netherlands East Indies, particularly in East Java, coffee cultivation is of considerable importance, the annual production amounting to about 2,000,000 piculs. Suitable soil and a large population place Java in a more favourable position as compared with this country for the production of coffee. Almost half the coffee produced in the Netherlands East Indies is grown by Javanese.

There does not appear to be any likelihood of much expansion of coffee planting on the plains in Malaya. Arabian coffee is, however, being grown experimentally by the Department of Agriculture at Cameron's Highlands, Pahang, but it remains to be seen whether circumstances justify the planting of this crop on a large scale on the hills in this country.

History.

Arabian coffee is recorded as having been grown in Malacca in the eighteenth century. This coffee, however, never proved a success on the plains in Malaya although many attempts in the past were made to cultivate it on an estate scale.

The cultivation of coffee in this country owes its inception to the introduction of Liberian coffee in 1875. It appears to have spread rapidly throughout the Peninsula. The introduction of Liberian coffee is referred to by Ridley

(*Agricultural Bulletin, S.S. & F.M.S.*, Vol. IV, page 301, "History of Economic Plants") as having originated what may be termed "planting" on an estate scale in Selangor, Perak and Negri Sembilan. The planting of coffee was particularly timely as it enabled rapid interplanting with Hevea and thus assisted the early expansion of the rubber industry in Malaya.

In 1894, the exports of coffee from Selangor and Perak were about 4,000 piculs, (1 picul = 133⅓ lbs.) increasing to some 16,000 piculs in 1897, when Negri Sembilan produced about 1,000 piculs. By 1901, the export of coffee from Selangor, Negri Sembilan and Perak had risen to 51,239 piculs. The peak year appears to have been 1905 when 107,218 piculs were exported, mostly from Selangor. By this time, however, the coffee estates were largely interplanted with rubber and production of the former crop began to fall rapidly. Interest in Liberian coffee was mostly confined to the period between the years 1875—1898, after which, owing to the fall in the market price of coffee, due to increased output from Brazil, and appreciation of the possibilities of rubber, coffee planting almost entirely ceased and in course of time rubber claimed the majority of coffee estates. A bad attack of the caterpillar of the bee-hawk moth (*Cephonodes hylas*), which occurred in 1900, resulted in considerable damage to many coffee estates in Selangor.

During 1900, *Coffea robusta* was introduced and might have been extensively cultivated but for the planting of Hevea.

In 1910, the total area under coffee was 6,475 acres, almost entirely in the Federated Malay States and practically the whole of this coffee was grown as an intercrop with rubber and coconuts. The planted area in the Federated Malay States gradually decreased to about half, but with the inclusion of Johore, the total area under coffee in Malaya is now shown as 12,907 acres, which is made up as follows—Federated Malay States 9,059 acres, Straits Settlements 848 acres, Johore 3,000 acres.

Varieties.

For the purpose of this paper, attention is directed to the three main types of coffee, namely; Arabian, known in the Netherlands East Indies as "Java coffee", Liberian and robusta. In addition, brief reference is made to several promising species which have been established at the Government Plantation, Serdang. Among other cultivated coffees may be mentioned the following hybrid forms, which have met with some success in Java:—

Maragogipe coffee—a mutation of arabica, production often small but yields a large bean of excellent colour and flavour.

Kalimas hybrid—liberica x arabica, stated to be practically immune to leaf disease.

Kawisari hybrid—liberica x arabica, a robust hybrid with arabica-like beans.

Liberian Types.

Coffea liberica.—A sturdy tree attaining a height of 30 feet, indigenous to Liberia, West Africa; introduced into the East Indies in 1875. The leaves are large, leathery, deeply wrinkled, pointed at the apex, glossy and oval.

The flowers, of which several are produced in each cluster, are large and pure white in colour. The fruits are large and very variable in size. The colour of the ripe berry varies from yellowish to dark red. The skin and pulp layer are thick. The proportion of fresh fruit to prepared beans is usually about 10 to 1.

Coffea excelsa.—A large tree discovered in the Congo in 1904. The branches are coarser and thicker and the leaves larger than *C. liberica.* The berries are smaller than the last named species and darker in colour. The skin is soft and tender. Flowers white, with green stamens, produced in axillary cymes, 1—5 flowers in each cyme. A good type of coffee that will thrive from sea-level up to 4,000 feet. The proportion of fresh berries to dry beans is about 7·5 to 1.

Robusta Types.

Coffea robusta.—A small tree about 10 feet high, collected in the Congo region of Africa in 1900. The tree is umbrella-shaped with long branches bending towards the earth Leaves large wrinkled, thinner than *C. liberica.* Flowers white, produced in dense axillary clusters. Fruit green when unripe, becoming deep red with a purple tinge when ripe. About half the size of *C. liberica,* outer skin thin. *C. robusta* is hardy and flowers early, and for this reason it is commonly used as a catch crop with permanent cultivation. The percentage of fresh berries to prepared beans varies from 3·5 to 1 and 5·5 to 1 according to type and soil conditions.

Coffea canephora.—A small tree of the robusta type, collected in Gabon, Africa, and described in 1897. It is a very variable species. The young berries are bronze-coloured, turning vermilion when ripe. The leaves are distinct, being narrow and tapering to a fine point, leathery and flat. This coffee is a heavy yielder and produces berries of good quality; the proportion of fresh berries to dry beans is about 4·5 to 1. In Java it has, unfortunately, been found very subject to leaf disease.

Coffea Quillou.—A robusta-like species introduced from the French Congo in 1901. The plant is less variable than many other species and is characterised by the rust-brown colour of the young leaves. When mature the leaves of Quillou are lighter green than those of robusta. The ripe berry is bright red, the proportion of fresh berry to dry beans is about 4 to 1. The trees come into bearing a year later than *C. robusta,* but produce large crops under suitable conditions. Unfortunately it appears more susceptible to the coffee-berry borer than other varieties.

Coffea Uganda.—This coffee was introduced from East Africa, as its specific name indicates. The leaves are smaller than those of robusta, being markedly undulating at the edges and curving upwards. The berry is light to bright red. The flowers are smaller than those of the robusta-like species. The proportion of fresh fruit to ripe beans is 4 to 1.

Arabian Type.

Coffea arabica.—A shrub reaching a height of 20 feet when fully grown; indigenous to Abyssinia, Sudan, Guinea, and Mozambique. It is stated to

have been introduced into Arabia during the fourteenth century and subsequently became distributed throughout the warm countries of the world. Arabian coffee has been cultivated in the East for over two centuries. The bark is thin and grey in colour. Leaves elliptical or oval with pointed tip. Flowers pure white, very fragrant, numerous in the axils of the leaves. Berry dark red to yellowish-red. Flesh of fruit very sweet. Arabian coffee was at one time much grown in Ceylon and Java, but in 1869 the coffee leaf disease (*Hemileia vastatrix*) appeared in the plantations resulting in its cultivation being almost abandoned within a few years. This coffee thrives best at high elevations in the eastern tropics. The proportion of fresh fruit to prepared beans is approximately 5.5 to 1.

Soils and Situation.

Coffee requires a fairly fertile soil, which is loose and porous, and does not contain hard impermeable layers to impede the growth of the tap-root. The bushes are not deep-rooting and about three feet depth of soil is sufficient for their requirements. The root development of coffees, especially robusta, is comparatively rapid and intense and the most suitable soils are those which permit of ready root ramification.

Liberian coffee is most suited to the peaty soils of the coastal district and where efficient drainage is undertaken, to counteract the natural acidity of the soil, excellent growth is made and good crops of berries are obtained. It may be grown most successfully from sea-level to 1,000 feet.

Robusta is stated to be sensitive to soil acidity and does not thrive on the coastal soils. The best results are obtained on inland virgin land, particularly that of granitic origin. This variety can be grown from sea-level up to 2,500 feet.

Arabian coffee is more suited for cultivation on the hills, where it produces beans of excellent flavour. There is little actual experience of the requirements of this species in Malaya, but several small areas at the Experimental Plantation, Cameron's Highlands (4,750 feet elevation) are thriving well. Owing to the susceptibility of this coffee to leaf disease, its cultivation in the East has steadily declined. It thrives best at elevations of 2,000 to 4,000 feet and is totally unsuited for cultivation at sea-level.

Cultivation.

Propagation.—Coffee is ordinarily propagated from seed, though recent work in Java has proved that improvements can be obtained by planting fields with stocks upon which superior clones have been grafted. This mainly applies in the case of robusta and hybrid coffees, which are naturally variable when grown from seed.

Seed for planting should be taken from strong healthy bushes which are known to give good crops The seed should be carefully selected from perfectly ripe berries and, after depulping, mixed with dry ashes and spread out to dry

in a warm shady place. After drying, the seed should be sown as soon as possible in raised nursery beds.

The nursery should be in a sheltered situation, having good drainage, preferably on virgin soil free from all roots, and with ready access to water. The nursery beds, which are usually made about 4 feet wide and 1½ to 2 feet apart, should be well shaded with "ataps." An economical method for raising a large number of seedlings is to prepare nursery beds under the shade of light jungle or "blukar." This method has been employed at the Government Plantation, Serdang, with conspicuous success. The seeds are sown about half an inch deep at distances of about 6 to 9 inches apart, according to the length of time the plants are to remain in the nursery. The number of seeds per pound varies according to the variety. In the case of robusta about 1,600 seeds go to a pound, which should be sufficient to plant up an area of 3 acres, after allowing for failures in germination, with 435 plants to the acre. After sowing, watering and weeding must be attended to and, should the surface soil become caked, a light forking should be undertaken to maintain it in a friable condition. Under normal conditions, the seed will commence to germinate within 6 to 8 weeks from sowing and germination may continue for a further period of at least 6 weeks. The shade should be removed gradually so that the seedlings are fully exposed when they have four pairs of leaves, at which stage they are ready for transplanting in the field. The seedlings may, however, (if necessary) be allowed to remain in the nursery for 6 to 9 months.

Planting.—The land having been cleared and drained, should be holed a month or so previous to planting. The holes should be 2 feet deep and at least 1½ feet square. The seedlings should be transplanted at the commencement of the rains, thus enabling them to become established before the dry weather sets in. As is generally known, it is essential to avoid a bent tap-root when planting coffee. Should the tap-root protrude from the transplanter the exposed portion must in every case be removed with a sharp knife.

The planting distances recommended for the several types of coffee are as follows:—

Liberian	12 ft. × 12 ft.	=	302	bushes per acre.
Robusta	10 ft. × 10 ft.	=	435	,, ,,
Arabian	6 ft. × 6 ft.	=	1,210	,, ,,

After planting, the land should preferably be kept clean weeded, since coffee cannot withstand a heavy cover plant or weeds round its roots. Experience at the Government Plantation, Serdang, has proved conclusively that low-growing cover plants seriously retard the growth of coffee. Provision should always be allowed for supplying vacancies and when undertaking this operation all sickly or stunted plants should be removed and replaced by healthy seedings.

Shade.—As already stated, coffee is a shallow-rooted plant, with lateral roots spreading out near the surface of the soil. Shade is therefore beneficial not only to protect the roots from drying out but to provide the surface soil with a mulch of fallen leaves. In the early stages of growth, *Tephrosia candida*, or other similar tall-growing leguminous plants, may be grown between the

rows of coffee. Leguminous trees, such as *Gliricidia maculata* and *Erythrina* spp., should be planted at distances of about 20 ft. by 20 ft. apart in order to provide high shade.

Pruning.—The primary object of pruning is to improve the form of the bush so as to encourage the maximum production of berries by allowing free access of light and air round the main stem.

When the plants are about one year old, all suckers and superfluous stems should be periodically removed to prevent the formation of excessive branches. Double stems should be cut with a sharp pruning knife, but the suckers at the base of the main stem are best broken off by hand while they are comparatively small.

After the majority of bushes have attained a height of about 7 or 8 feet, the main stem should be pruned back with a sharp knife to within a height of about 5 or 6 feet and the cut should be made in a sloping direction about one or two inches above a primary or lateral branch emerging from the leading stem. It is important that only those stems with brown or mature wood should be topped. This treatment, which is known as "topping," causes the secondary and tertiary branches to develop strongly so that thinning out of the latter must follow in due course.

The branches which arise straight from the main stem are known as "primary" or lateral branches. These again develop side shoots, in pairs, which are termed secondary branches. Normal pruning is not usually undertaken until the third or fourth year. In carrying out this operation all secondary branches within about 6 or 8 inches of the main stem should be cut away and afterwards alternate secondaries on each side of the primary or lateral branch should be thinned out.

Further, the pruning of lateral cross branches, particularly those growing towards the main stem or those growing upright and parallel with the stem, should be periodically carried out at intervals of about 6 months.

It is obvious that each species or variety of coffee requires different treatment and with robusta or Quillou types of coffee the removal of secondaries is not so necessary as in the case of the Liberian types. In fact, in the case of the robusta or Quillou types of coffee, very few secondary branches are formed and attention need only be given to the periodical pruning of suckers on the main trunk and the removal of one or two leaves which develop on the upper sides of the lateral branches and which have a tendency to cover up the ripening berries.

The removal of suckers from the main stem should be carried out regularly every 6 to 8 weeks, otherwise their growth will very soon exhaust the bushes and the yield of fruit will become adversely affected.

Coffee as a Catch Crop.

In considering coffee as a catch crop with permanent cultivations such as rubber, coconuts, and oil palms, it has to be borne in mind that little or no crop

may be expected from the coffee after the fifth year. In the case of oil palms the growth of the palms is so rapid that the coffee is crowded out during the fourth year. This difficulty may be partly overcome by planting the coffee at least one year ahead of the main crop.

Robusta is the most suitable type of coffee for this purpose as it produces comparatively good crops during the third and fourth year after planting. Liberian coffee is often grown as an intercrop with coconuts in the coastal districts and under such conditions is frequently profitable. Robusta coffee is more suitable for inland soils and provided the principal crop permits of a fair lease of life to the coffee, and the soil is sufficiently fertile, it may be grown on a profitable basis. Arabian coffee appears to be more suited as a sole crop on the hills.

Manuring.

Coffee is not a very exhausting crop and if planted on rich virgin soil it should not require manuring until it has been in bearing for a number of years. In fact, it exhausts the soil so slowly that even on comparatively poor land it may remain productive for 4 or 5 years without the application of manure.

The judicious use of green manures, such as *Tephrosia candida* or *Crotalaria anagyroides*, provided the prunings are periodically incorporated with the soil, will assist materially in maintaining soil fertility.

Experience in other countries has shewn that undoubtedly the best manure for coffee is cattle manure and as the supply of this is usually inadequate it may be necessary to resort to the use of artificial fertilisers. When cattle manure is not available it may be substituted by a compost consisting of coffee husks, dried pulp, well-rotted grass, weeds and other crop residues with a mixture of wood-ashes, which should be allowed to decompose thoroughly before being applied to the soil.

Although little definite information is available regarding the most suitable mixtures of artificial fertilisers for coffee it is recommended that a trial be made with a complete mixture, as usually adopted in Southern India, consisting of 100 lbs. sulphate of ammonia, 200 lbs. of superphosphate and 100 lbs. of sulphate of potash as a standard dressing at the rate of 400 lbs. per acre every alternate year.

Artificial manures should always be applied at the beginning of a dry season and it is advisable to broadcast the mixture between the rows of coffee and fork it lightly into the soil. The artificial manure should always be placed near the extremities of the feeding roots and not round the bole of the bush.

An application of about 8 to 10 piculs of freshly burnt lime per acre, a few months before applying the mixture of artificials, will often given beneficial results on the more acid types of soils. The lime should be first of all air-slaked under an open shed, then broadcasted as a fine powder and lightly forked below the surface of the soil.

Diseases and Pests.

The diseases and pests that attack the coffee bush are serious and have resulted in great loss to coffee planters in the past.

The most serious disease is the coffee rust or leaf disease (*Hemileia vastatrix*). In the nursery or early days in the field this disease may be kept in check by hand-picking or spraying with copper sulphate solution. Experience in Java shows that little can be done to control this disease once it becomes established in a coffee estate. Further experience in that country indicates that the Liberian and robusta varieties are becoming more susceptible to the disease. Pink disease (*Corticium salmonicolor*) attacks the woody parts of the bushes and sometimes causes serious damage. There are also various root rots, not yet well known, the commonest being brown-root disease.

About thirty years ago, when Liberian coffee was extensively planted in Selangor, considerable damage was done to the bushes by caterpillars of the bee-hawk moth (*Cephonodes hylas*). This pest may be controlled by hand-picking the caterpillars or spraying with lead arsenate. Steps should be taken to eradicate the caterpillars as soon as noticed, otherwise there is a possibility of this pest getting out of control.

Recently the coffee berry-borer (*Cryphalus hampei*), a small beetle which bores a hole into the green or ripe berry, has made its appearance in this country. This is considered to be a serious pest in Java and difficult to control, since its spread is facilitated by the transport of bags and other material, from one estate to another. The Quillou variety appears to be more susceptible to this pest than any other variety. *Lecanium viride*, a small greenish-coloured scale insect, is often troublesome. It may, however, be controlled by spraying with kerosine emulsion.

Harvesting.

In the Liberian types, the fruit is borne throughout the year, during which time two fairly heavy crops may be expected, one about May/June and the other about December/January. The collection of fruit, however, goes on all the year round. Only ripe berries should be harvested as the pulper cannot deal with unripe fruit.

The robusta types blossom throughout the year and the berries should therefore be collected once a month. The fruits mature within about ten months from flowering and are ready for picking when the greater number in the cluster are straw-coloured; the whole cluster may be generally gathered at once.

The Arabian or "Java" coffee also flowers spasmodically throughout the year; harvesting, therefore, is more or less continuous.

In picking coffee, it is most important that the berries should be perfectly ripe and care should be taken that no immature or over-ripe berries are mixed with the main crop. The bushes are inspected several times and the ripe berries collected at each round until the crop is harvested. Additional labour will be required during the heavy cropping seasons and at such times

the harvesting is usually carried out on contract. After the last picking round is completed, it is the practice in some countries to strip off all the remaining berries, whether ripe or not, and collect all fallen berries. This fruit is of inferior quality and is therefore kept separate from the main crop, being sold as second grade coffee.

Yields.

Yields are dependent upon both the variety and the soil conditions. With Liberian types, the bushes commence to produce fruit about three years from the date of planting and are considered to be in full bearing after the fifth or sixth year. The average yield of Liberian coffee in full bearing is about $3\frac{1}{2}$ to 4 piculs of beans per acre. The life of this coffee is from 25 to 30 years.

Robusta coffee commences to flower early, often when the bushes are only nine months old. A small crop of fruit may be collected in the second year while the maximum will be obtained in the fourth year. Yields during the third year are 2 to 3 piculs of beans per acre and from the fourth year onwards a return of 4 to 6 piculs of beans per acre may be expected. Robusta coffee will continue to yield satisfactorily for a period of 10 to 12 years.

Definite information regarding yields of Arabian coffee in this country are not available. Yields in Java, however, are stated to be somewhat less than those obtained from robusta coffee.

Preparation.

When the berries are brought to the factory by the pickers they are either measured or weighed and then placed in a receiving tank.

In this country, the wet-method of preparation is the one most commonly practised and as it requires large supplies of water it is essential that the factory should be situated near a plentiful supply of fresh water.

In order to obtain the best results by this method it is most important to see that the berries are quite ripe and treated the day they are picked. If pulping is delayed for any length of time the berries will begin to ferment, which causes the beans to became discoloured.

The principal operations in the preparation of coffee, which consist of pulping, fermenting, washing, drying and hulling, may be briefly described as follows:—

Pulping.—The removal of the pulp surrounding the beans is effected by means of de-pulping machines. The concrete receiving tanks, which are constructed with a sloping base, should be placed at a higher level than the pulper and fitted with a $2\frac{1}{2}$ inch pipe for supplying a constant supply of water. The berries are delivered direct from these tanks in a stream of water to the hopper of the pulper, where the outer skin is disintegrated by means of vertical iron discs, covered with copper, having a surface of numerous blunt projections. These discs revolve against the adjustable steel pulping bars, the pulp and beans being delivered at separate outlets. A certain amount of partially pulped

or unpulped berries generally pass through with the beans and these may be separated by a rotary screen, the unpulped material not passing through the mesh in the screen being returned to the pulper and re-pulped. A quantity of pulp is sometimes carried through with the beans in which case the mass is placed in a shallow tank containing water, where it is stirred vigorously. The light pulp then floats to the surface and is removed by withdrawing the water from the top of the tank, the heavy parchment remaining at the bottom. It is most important that the steel cutting bars on the pulper should be properly adjusted, otherwise the beans will become cut or bruised and spoil the sample.

Fermenting.—When the depulped berry, known as parchment, comes from the pulper it is covered with a slimy substance and this is removed by fermentation. During this process the parchment is washed into concrete tanks where, after removing the water, it is covered with gunny sacks and allowed to ferment for a period of 30 to 36 hours. The fermentation tanks are usually about 3 feet deep and constructed with a sloping floor so that the water can be run off through a perforated steel plate, which retains the parchment.

During fermentation a certain amount of heat is generated and this decomposes the sugary coating on the bean so that when the process is complete the slimy covering can be easily removed by washing. When the operation is complete the parchment has lost its slimy feeling and is somewhat rough on being grated in the hand. The process of fermentation depends on the temperature of the air, consequently the time taken for coffee to ferment properly will vary somewhat at different periods of the year. It is therefore necessary to make periodical tests in order to ascertain when the fermentation is complete, otherwise it may be carried on too far with the result that the quality of the coffee will be impaired.

Washing.—When fermentation is complete, the parchment should be trampled into a sticky mass in the tanks and then covered with water. The water is afterwards run off and the parchment then turned into concrete washing channels containing a plentiful supply of running water, where it is stirred with wooden paddles against the flow of water until it is perfectly clean, when it feels quite rough. Any floating or other imperfect beans are skimmed off and classified as inferior grade coffee.

Drying.—After washing, the parchment is allowed to drain for a while and is then evenly spread about one inch deep on a cement barbecue to dry in the sun. The beans should be periodically turned and not allowed to become wet, either by rain or dew, during the operation of drying, which may take from 8 to 10 days to complete.

On large plantations artificial drying might be practised with advantage, since by this method the parchment can be thoroughly and evenly dried within a period of about 48 hours by the use of hot-air driers.

When the parchment is entirely dry it is quite brittle and the bean is so hard that it cannot be dented by the teeth. It is most important that coffee should not be stored in bulk until it is thoroughly dry, otherwise it will ferment and the beans become musty.

Hulling.—The next operation is the removal of the parchment, which is usually carried out by hand. The broken outer shells and the silver-skin are then separated from the beans by sieving and winnowing, after which the coffee is graded according to size and colour.

Marketing.

When the coffee is quite dry it should be bagged and marketed as quickly as possible, since if it is stored for any length of time after hulling the beans commence to deteriorate in quality.

At the present time, coffee is only grown in Malaya for local consumption and the demand in the local markets is for a large bean of the Liberian type, which would find little sale on the London market, where the demand is for the smaller-seeded types such as robusta and arabica.

Liberian types of coffee are unpopular on the London market on account of their peculiar flavour.

Although considerably higher yields are obtained on the plains than on the hills the coffee is inferior in quality and, consequently, realises a lower price on the Home markets, where the present demand is for the finest grade only. Coffee grown at high altitudes has a distinctive flavour and is therefore largely used for blending with inferior qualities.

As already stated, since the world's visible supplies of coffee are greatly in excess of consumption and are considered likely to continue so for some time to come, the production of other than first grade coffee for the London market cannot possibly be recommended. Local consumption is, however, fairly considerable and there appears no reason why this demand should not be met by Malayan produce.

THE EFFECT OF COVER CROPS ON SOIL MOISTURE

BY

W. N. C. Belgrave,

Plant Physiologist.

Cover crops have become a standard part of agricultural practice in Malaya of late years as valued aids in the fight against soil erosion, which is necessarily active because of our frequent and heavy rains.

The efficacy of covers as soil retainers is indisputable, but there is little information as to their effect in other directions on the soil and the crop. Points on which information is badly needed are:—effect of covers on the microbiological flora of the soil, the soil atmosphere, humus, quantity of readily available nutrients and moisture. One school of thought stressing, perhaps unduly, high soil temperatures in bare soil, assumes that covers must always be beneficial; the other stressing, again perhaps unduly, the competition which must be set up between cover and main crop for the relatively small quantity of soluble nutrients existing at any given moment in our soils, considers that covers may be harmful and should be employed with care—especially in the case of young main crops. Neither school of thought has as yet definite evidence to support their views. In order to test these and other points which may arise, the Agriculturist S.S. & F.M.S. has laid down a series of plots at the Government Experimental Plantation Serdang where different covers can be grown for a term of years and their effects on the soil and crop studied by various Divisions of the Department. There are two plots, one on flat land on a moderately light soil, the other on a steep, bare and somewhat heavily washed hillside. Unfortunately the covers on the latter plot have grown very badly, and no useful observations can yet be made. On the flat block there is one control plot which is left clean weeded, on the hill two controls, one clean weeded and the other silt pitted. Each plot of cover or control is $\frac{1}{4}$ acre in extent in the form of a narrow rectangular strip.

The covers were planted in November, 1929. Best growth was made by *Centrosema pubescens, Calapogonium* and *Mikania scandens*. Observations on moisture were started on 1st May, 1930.

A few preliminary observations on a somewhat similar soil type made a few years ago had indicated that no great differences between cover and clean weeded plots were to be anticipated; it was therefore clear that a number of samples would have to be taken on any one day, in order to reduce experimental error as far as possible.

The quantity of moisture in the soil at any given level at any given time is the result of a balance between different factors—of which on the positive side we have (a) rainfall, (b) retention of rain, (c) capillary rise of water from lower to higher soil levels and on the negative, (d) surface loss as vapour, (e)

percolation downwards below root level, (f) run-off. Of these (a) and (c) are unaffected by covers while (d) is the factor likely to be most affected; on the one hand we have a lower soil temperature but transpiration from the leaves of covers; on the other, possibly intense evaporation from hot bare soils. Other subsidiary changes may be tabulated as follows:—

Land under cover.	*Bare land.*
Interception of part of the rainfall by cover and subsequent evaporation therefrom, the water not reaching the soil at all.	All rain reaches the soil surface.
Considerable reduction of the run-off from heavy showers, more time for water to penetrate soil.	High percentage of run-off—especially when soil surface becomes "packed."
After some time, especially if crop is turned in at intervals, organic content of soil may be raised with consequent increase of water-holding capacity. This however requires further investigation.	

All these subsidiary factors, with the exception of the last, should operate in favour of the cover as the slope of the land and the heaviness of the soil increases—results showing no difference or a difference favourable to covers obtained on the block under investigation, which is flat and on comparatively light soil, should therefore be applicable with some certainty to any other situation, although the reverse would not necessarily hold.

Since it is obvious by inspection that the surface (two inches) of the clean weeded plot was always drier than that on the covered plot and since this portion is of little or no importance to the roots of any tropical crop it was neglected and samples taken at successive depths of 2″-6″, 6″-12″, 12″-18″ with a golf-green auger. Six bores were made on each plot.

Each sample was well mixed by hand in a tray and a tin holding about 200 grams of soil was then completely filled and tightly covered. As soon as possible the tins were brought into the laboratory, and a sample of about 30 grams of soil obtained by successive quarterings was dried out for moisture content. As anticipated, considerable—but not excessive—variation was found in the moisture content of comparable samples from the same plot on the same day. Statistical treatment indicated that a moisture difference of less than 5% of moisture on any one day could not be regarded as "significant" i.e. that it might be due to chance. A smaller difference on successive dates of similar weather conditions would be significant provided the difference was always or nearly always in the same direction.

Inspection of the means given below shows that no differences of 5% on any one date were found, nor was there any constancy of direction of difference—in other words, as far as these experiments go, the covers tested have

neither increased nor significantly diminished the water in the soil under weather conditions ranging from moderately wet to very dry.

This result indicates that the various factors affected by the change from bare land to covered land have in this experiment approximately balanced.

For reasons given above, such results obtained on this block may be taken as applying to practically every situation likely to occur in Malaya and it seems legitimate to conclude that no fear need be entertained of harmful effects of covers *on the score of reduction of soil moisture content* even of young crops.

On the other hand, there is no evidence that crops growing on bare flat land of the type dealt with would suffer from drought.

The reservation italicised above is important as many other factors have to be considered which may not necessarily follow the same line. To give one example, nitrate determinations on these soil samples show conclusively that traces only of nitrate exist in the soil carrying covers, while the bare soil contained appreciable quantities (3-4 parts per million nitrogen as nitrates). This and other factors will be dealt with as information becomes available.

The writer desires to express his thanks to Messrs. J. N. Milsum and T. D. Marsh, Assistant Agriculturists, for help in carrying out the observations.

TABLE A.

Means of moisture contents. Percentage.

Date.	Position.	Centrosema.	Bare.	Mikania.
1.5.30	Top	30.1	28.2	30.9
	Middle	31.5	27.5	32.7
	Bottom	31.7	29.8	32.1
15.5.30	Top	21.2	24.8	28.8
	Middle	23.6	26.5	29.6
	Bottom	24.0	27.2	30.1
29.5.30	Top	17.2	19.0	19.9
	Middle	20.9	22.8	23.1
	Bottom	23.1	24.6	24.7
8.7.30	Top	18.5	21.0	20.9
	Middle	21.1	25.5	23.8
	Bottom	23.2	25.7	24.7
8.8.30	Top	15.8	19.6	17.5
	Middle	20.5	22.0	22.0
	Bottom	22.0	23.2	21.7

TABLE B

Example of actual moisture contents found (percentages).

May 15th, 1930.

CROP.	POSITION.		
	Top.	Middle.	Bottom.
Centrosema ...	14.8	19.7	18.5
	24.5	28.1	28.1
	24.1	25.2	25.6
	22.0	21.5	26.2
	22.2	23.5	20.2
	19.5	23.8	25.6
No Crop ...	25.8	29.4	31.5
	28.7	30.5	30.8
	19.0	21.0	22.6
	22.9	27.7	27.6
	26.2	25.6	29.6
	26.1	24.8	27.4
Mikania ...	30.8	35.1	32.8
	32.2	30.5	30.8
	28.3	27.4	31.5
	29.1	30.4	30.6
	27.7	27.7	29.4
	24.9	26.1	25.8

TABLE C.

Rainfall for weekly periods.

Date.	Total Rainfall, inches.	Number of Rainy Days.
April, 1930.		
1-7	3.63	6
8-14	3.19	3
15-21	1.77	3
22-28	5.68	3
29- 5th, May	2.99	5
May, 1930.		
6-12	2.28	3
13-19	—	—
20-26	—	—
27- 2nd, June	—	—
June, 1930.		
3-9	2.04	4
10-16	1.75	4
17-23	1.33	3
24-30	—	—
July, 1930.		
1-7	.20	1
8-14	.21	2
15-21	.30	1
22-28	—	—
29- 4th, August	—	—
August, 1930.		
5-11	.71	3
12-18	.37	2
19-25	2.17	3
26-31	3.32	5

THE PALM OIL FACTORY AT ELAEIS ESTATE, JOHORE.

The following account has been prepared by the Department of Agriculture, S.S. and F.M.S. with the Assistance of Messrs. Guthrie & Co., Ltd., and the Staff of Elaeis Estate, Johore.

The inauguration of the new palm oil factory of Elaeis Plantations Limited, which was officially opened by His Highness the Tungku Makota of Johore on Sunday the 10th. August, 1930, affords an opportunity for a brief account of this undertaking which, it is considered, may be of interest to readers of the *Malayan Agricultural Journal* inasmuch as it represents the first palm oil plant that has been erected in Malaya in which the oil is expressed from the fruit by means of hydraulic presses. In Malaya, all the palm oil factories which have been erected hitherto have utilised the centrifugal machine for the extraction of the oil from the fruit. There are a number of factories of this type in existence and their lay-out is fairly well-known, but the design and construction of the plant at Elaeis Estate differs in a number of other respects from existing installations.

The plant is housed in a steel-framed building covered with corrugated galvanised iron; in general appearance and type it resembles closely those which have become familiar in sugar-growing countries as the standard type construction for sugar factories. The overall dimensions of the building are as follows:—

Length.	Breadth	Height.
164. ft.	56 ft.	52 ft.

General Description and Working of Plant.

The bunches of oil palm fruits are harvested and placed direct into perforated wrought iron cages in the field, then transported to the factory on light railway by means of a small steam engine. The cages, which are semi-circular in shape and provided with side doors, have a capacity of about $1\frac{1}{4}$ tons of fruit bunches each and two of these are carried on each field bogie. The trucks on arrival at the factory pass over a weighbridge and after the weights have been noted, the cages are lifted from the field trucks and placed on special steriliser trollies, which are fitted with ball-bearings to facilitate handling.

Steriliser.—These trollies are conveyed on rails into the bunch steriliser, which consists of a cylindrical container having an internal diameter of 1,700 mm. and an overall length of about 8 metres, capable of receiving three cages and the contents bodily so that the fruit bunches may be treated without unloading. The bunch steriliser is closed by means of a circular door capable

of being hermetically sealed. It is heated by means of live steam from the main steam range which is reduced by means of a reducing valve to 40 lbs. pressure per square inch, giving an internal temperature of about 130° Centigrade. Since the steriliser holds three cages, each containing $1\frac{1}{4}$ tons of fruit bunches, the sterilising capacity is $3\frac{3}{4}$ tons per charge. The sterilisation occupies one hour and it takes approximately 20 minutes to charge and discharge the trucks. Therefore, with a working day of 11 hours the steriliser can be charged 8 times, giving a total output of about 30 tons of fruit bunches per day.

Bunch Elevator.—When sterilisation is complete, the trollies are removed from the steriliser and transported on a rail system, fitted with turn-tables to facilitate handling, to the bunch elevator. The sterilised bunches are then discharged at the base of the elevator by opening the side of the cage. They are then fed into the elevator buckets and discharged on the stripper platform, which is the highest point in the building. The capacity of the elevator may be increased or reduced by changing the size of the pulley on the driving shaft.

Stripper or Threshing Machine.—The sterilised bunches are raked into a semi-circular iron grating between the bars of which rotate cast-steel beaters for stripping the fruit from the bunches. The grate is adjustable and should be fixed at such an angle as to allow of almost continuous working. In the stripper the fruit is threshed from the bunches and falls into worm conveyors, which carry it into the stirring-kettles. The small leaves and stalks, which are separated from the cleaned fruit by means of a strong current of air, are blown into the chute through which the empty bunches fall on being automatically discharged from the far end of the stripper.

Stirring-kettles.—These consist of steel cylinders 800 mm. in diameter and 1,285 mm. in height, which are steam-jacketed and fitted with revolving cast steel stirring arms, running at about 25 revolutions per minute, whereby the fruit is broken up. The steam jacket is subjected to a pressure of 118 to 120 lbs. per square inch, i.e. the normal boiler pressure.

First Presses.—The pulped mass is discharged into one of the first presses, the feeding of the latter being regulated by hand by means of an adjustable shutter situated at the base of the stirring-kettle. The all-steel first presses have cages with a diameter of 400 mm. and 650 mm. in height. The rams have a diameter of 150 mm. with a maximum stroke of 600 mm. The mashed fruit is packed into these presses in layers about 4 or 5 inches in depth, each successive layer being separated from the next by means of a steel plate, the function of which is to distribute the pressure evenly throughout the load when the press is charged and to facilitate handling of the press cake. The presses are worked very rapidly and are capable of manipulating 10 to 14 charges per hour, but working on the average at about 12 charges, which is equal to about 730 kilogramms of fruit per hour.

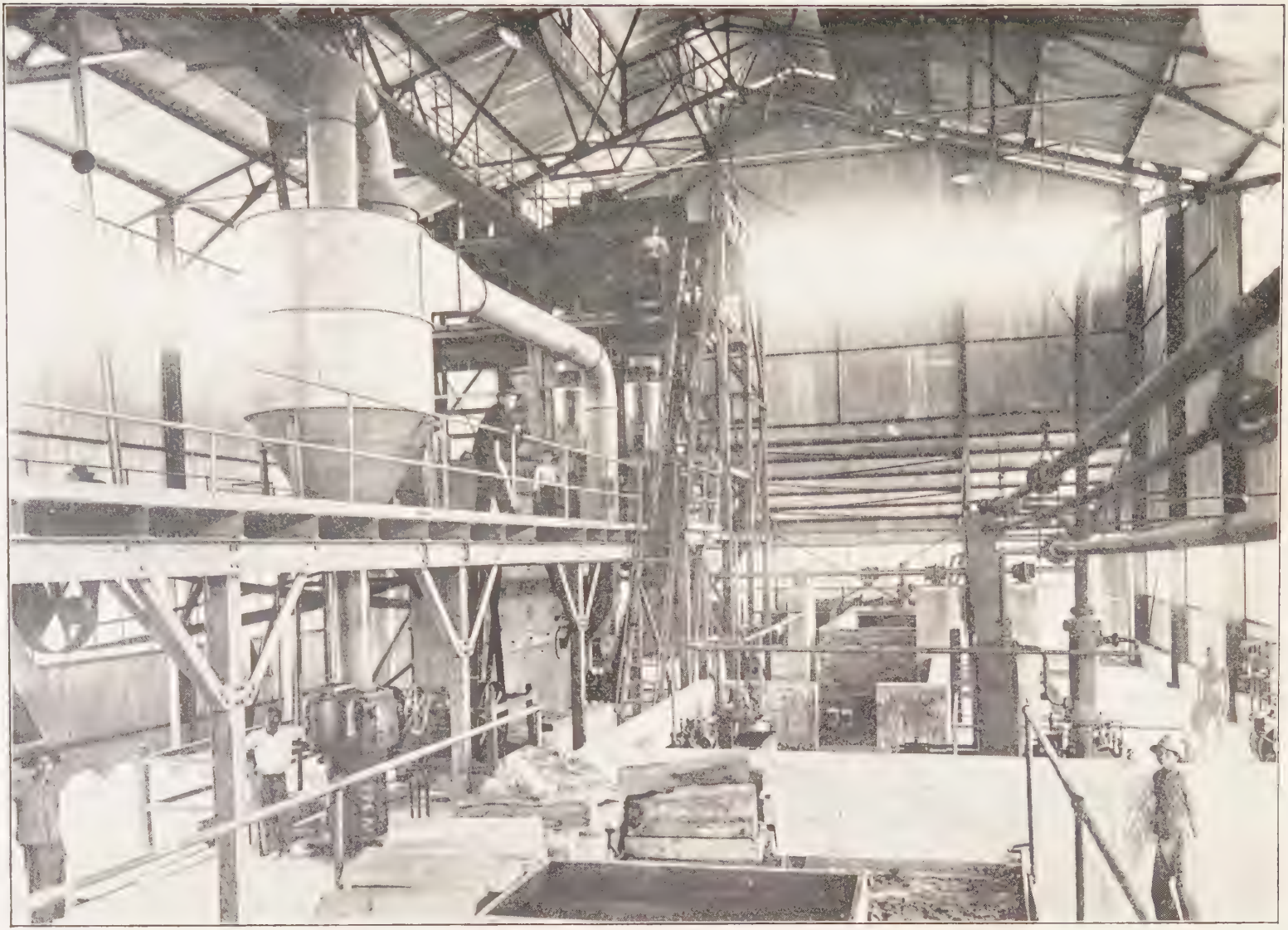
Duplicate first presses are provided, each press being operated by means of self-contained hydraulic pumps of special design without accumulators. The

usual pressure applied to the cake is 15 to 20 kilogramms per square centimetre, which corresponds to a pressure of 110 to 145 kilogramms per square centimetre on the ram. The pressure on the hydraulic pumps can be reduced or increased by adjusting the springs of the pumps and they are capable of developing a pressure of 480 kilogramms per square centimetre. It is stated that either ordinary lubricating oil or an emulsion of oil and water may be used in the hydraulic pumps. The cages of the presses are kept clean by means of a spray-pipe connected with the steam-jacket of the stirring-kettle.

The oil which flows from the presses during the operation of pressing passes to the crude oil containers. When the first pressing is completed, the cakes are pushed out of the press cages by means of the rams and thrown into a hopper situated between the two presses.

Drier and Depericarper.—The residue from the first pressing is discharged into a special form of drier consisting of a large closed tank-like chamber with three bands of perforated screens travelling backwards and forwards in the upper part and a horizontal drum rotating in the lower section. In this machine, the cakes fed in at the top from the presses, are first of all broken up by means of a rotating crusher, after which the mixture of nuts and fibre is spread out in thin layers on moving perforated slats or screens. At the end of each traverse an ingenious arrangement opens the slats of the conveyor and allows the materials to fall on to the next layer of slats. Hot air is forced through the drier by means of a fan, thus drying the fibre (and to a certain extent the nuts) as it is carried over the slowly moving slats. The dried material then drops to the rotating drum below, where the loose fibre is forced by a strong air-blast along a shaft leading to the second press. The nuts, which are too heavy to be lifted by the air current, are then rolled and rubbed clean of adhering fibre in the rotating drum. The cleaned nuts leave the depericarper at the end of the drum and fall into a bucket elevator, which takes them up to a worm-conveyor at the top of the building.

Second Press.—The fibre, from which most of the moisture has been removed, is pressed a second time under high pressure and all possible oil removed. The residue fibre is then taken to the boiler to serve as fuel. The operation and construction of the second press is similar to that of the first, except that it gives a higher degree of pressure. The all-steel second press has a cage of 400 mm. in diameter and 1,040 mm. in height. The ram has a diameter of 300 mm. while the maximum stroke is 1,010 mm. Like the first presses, it is steam-jacketed and works to a pressure of 480 kilogramms per square centimetre. Allowing for the first presses treating 1,250 kilogramms of fruit per hour this gives approximately 250 kilogramms of dry fibre per hour for treatment in the second press. Since the latter has a capacity of 40 kilogramms per charge and will take six charges per hour, one second press is capable of handling the output of two first presses. It is estimated that after the pulp has passed the second press the residual oil content ranges between 10 and 12 per cent dry fibre.



Interior of Oil Palm Factory, Elaeis Estate, Johore.

General View of Elaeis Estate and Oil Palm Factory.

Oil Collecting Tank.—The oil from both the first and second presses passes through pipes to an open tank and as required it is fed by gravity from there into a closed cylindrical tank. After closing the slide-valve, a jet of steam is admitted into this cylinder so that the oil is driven by pressure along pipes to either of the two settling tanks.

Clarification Tanks.—Each of these settling tanks has a capacity of about 5,000 litres of oil, which is equivalent to the amount of oil extracted during 10 hours, plus condensing water (added during the process of extraction) and sediment. Each tank is thus filled every alternate day, which allows ample time for settlement of the sediment and water. The crude oil in the settling tanks is heated with live steam, and also by steam coils from the base of the tanks, to a temperature of about 90 to 100° Centigrade, which assists in the separation of oil and water. After the contents of the tanks have been allowed to settle for some time, the sediment and water is drawn off into a sediment tank where the mixture is treated again with steam in order to recover as much oil as possible. The purified oil is then fed into a centrifugal separator for final purification after which it passes into the storage tank.

Storage Tank.—The storage tank for the final product has a capacity of 6,000 litres of oil. This tank is fitted with steam coils for indirect heating, but care has to be taken to see that the oil is not run off too warm otherwise it may melt the glue in the barrels. An automatic barrel-filler is fitted to this tank to facilitate the packing of the oil.

Conveyor for Drying Nuts.—The nuts after leaving the depericarper are taken by an elevator to a large perforated worm-conveyor, which is situated near the roof of the building. Hot flue gases are blown through the nuts as they pass slowly along the conveyor so that by the time they reach the end of the conveyor the nuts are sufficiently dry to allow of them being cracked without delay. This prolonged heating is necessary in order to ensure that the kernels are separated from the shell before cracking. The conveyor holds about 2,000 kilogramms of nuts, which is equivalent to an output of four hours working with 1,250 kilogramms of fruit per hour, and in order to obtain the highest efficiency it should always be filled. The output may be regulated by the removal of cast steel stirring arms attached to the shaft passing through the centre of the conveyor.

Nut-Crackers.—The dried nuts passing out of the worm-conveyor fall into a rotating sieve provided with scrapers and having slots of 18×50 mm., where they are sorted into large and small nuts. This separation is made to facilitate the separating of the kernels from the shells after the nuts are cracked. The two nut crackers are identical. The small nuts falling through the perforations drop down a chute into one of the centrifugal nut-crackers, while the large nuts leaving the sieve at the end are conveyed into a second nut-cracker. Each of the nut-crackers is provided with its own rotating perforated sieve into which the cracked material is conveyed by means of chutes. For the nut-cracker dealing with the smaller nuts the sieves are provided with 5×28 and 11×35 mm. slots

whilst the other has 6 × 30 and 14 × 35 slots. The smaller pieces of shells and dust fall through the smallest slots into a chute, whereas the remaining portion, consisting of large pieces of shells and kernels, fall through the second part of the sieve into the separator below. The uncracked nuts passing out through the end of the drums fall into a container and are returned to the nut-crackers.

Shell-Kernel Separator.—The separation of the shells and kernels is effected by allowing the material to fall into a shallow tank containing brine or clay having a specific gravity of 1.16 to 1.17. The shells, having a higher specific gravity than the liquid, sink to the bottom of the tank, while the kernels float on the surface. The kernels floating on the surface have a tendency to drift towards the rotating screen through which part of the clay or brine solution flows off. As the kernels pass along the latter part of the screen they are washed with clean water and are discharged from the separator. The wet kernels are then conveyed to a hot-air drier and packed direct into bags as they pass out of this machine. The broken shells which sink to the bottom of the separator are brought into a rotating screen by means of a wheel to which perforated buckets are attached. The shells are washed with clean water as they travel through this screen and leave the separator when they are taken to the boilers for fuel.

Power Unit.—The steam supply for the factory is maintained by means of a boiler of the Cornish type giving steam to the main steam range at 120 lbs. per square inch. The moving parts of the factory are operated by means of a horizontal single-cylinder steam engine of approximately 56 H.P., while a small electric light plant is also provided.

Output of Factory.—The estimated output of the factory at present is 825 tons of palm oil per annum, but this will be doubled when the second unit of machinery is added to deal with areas coming into bearing later on. Assuming an average output of approximately 16 cwts. of palm oil per acre per annum the factory will be capable of dealing with the output of a plantation of fully 2,000 acres, or with the installation of a third unit 3,000 acres can be dealt with.

General.—The layout of the buildings is excellent, the successive stagings and the large amount of clear space enabling a full view of practically all parts of the operation being maintained from the floor of the factory.

PADI EXPERIMENTS 1929—1930.*

Rice selection work has been carried on by the Department of Agriculture for a some of years past and a number of strains have been evolved which are known to be capable of giving higher yields than those normally cultivated.

Rice growing conditions vary greatly from district to district; and even within the confines of one district variations in soil texture and composition and in water supply—probably the most vital factor—are frequently considerable; consequently it is desirable that trials should be conducted in as many as possible of the larger padi growing areas. This policy is now being put into effect.

All experimental work on rice aims at an improvement in crop yields and this objective is being attacked from three different directions. Firstly, efforts are being made to improve the yields of existing rice fields by the selection of high yielding types of padi, testing them under the varying environment conditions found in different areas and by distributing the successful varieties to the cultivators for cultivation on a large scale. Secondly, investigations into the manurial requirements of padi are in progress, and when experiments shew definitely which manures are the most remunerative, steps will be taken to demonstrate their utility and to encourage their use. Thirdly, experiments towards improving existing methods of cultivating the rice fields are in progress and may reveal improvements which will react favourably on crop returns.

These three methods of increasing local production of rice are in operation in different experiment stations. Selection experiments are confined to Titi Serong (Krian, Perak) and Pulau Gadong (Malacca) experiments stations as it is considered that selections capable of satisfying the varying needs of the country can be made at these two stations. Stations for testing the relative merits of selected types have been established in various parts of the country, and some of these have also given useful results as demonstration stations and as centres of seed distribution. Manurial investigations have been conducted at four stations in the past. They have now been reorganised with the result that new experiments will be laid down at these stations in the next planting season. Experiments towards improving methods of cultivation have led to no definite results, but will be continued at these stations.

The work of the more important stations during the last padi season are summarised below.

Titi Serong Padi Experiment Station, Krian.

This station, comprising 21 acres of padi land, is situated in the Krian irrigation area—the most important rice growing district in the Federated Malay States.

Selection experiments are chiefly concerned with two popular types of padi, Seraup—an eight-month variety which normally gives heavy crops and has a good milling type of grain and Radin—a six-month variety, yielding fair crops and is the more favoured as a rice by the Malays.

* Abstract of a Summary prepared by the Economic Botanist, S.S. and F.M.S. on "Padi Experiments conducted in the S.S. and F.M.S. during the Season 1929-1930.

In addition to the Seraup and Radin selections, a collection representing all the chief varieties of padi grown in Malaya is maintained. This collection of "foundation stocks," numbering some 250 lines, contains several very promising types. Popular types of padi found in different rice growing areas throughout the country are sown from bulked seed at Titi Serong and then subjected to line selection, the most promising lines then being returned to their district for field trials—often with satisfactory results although under Krian conditions they may be only of average utility.

An experiment to test the relative adaptability of mixtures of the best pedigree strains was initiated in the last season; good crops were obtained. Possibly in a bad season, seed mixtures of the best strains might prove advantageous in comparison with seed of a single pedigree strain.

The technique of hybridisation of padi has been perfected and crosses made in an endeavour to combine the better characteristics of the best strains isolated by selection.

The Titi Serong Experiment Station has been used in the past as a seed distributing centre, and this function of the station will be continued for the present. During and after the last padi season, 45 tons of seed padi were purchased for seed distribution in the coming season when efforts will be concentrated on improving the yields in the two poorest producing areas of the Krian District. The District Officer will undertake to be responsible for the organisation of distribution in his district.

Other work performed at this Station was concerned with manurial experiments, studies of padi pests, and the compiling of meteorological data. The station was also used as a training centre for Padi Inspectors.

Pulau Gadong Padi Experiment Station, Malacca.

This station is situated five miles from Malacca town and consists of 25 acres of average padi land.

The station is designed to carry out experiments on selection, manuring and cultivation of padi, with the object of improving crop yields in Malacca territory.

The chief varieties of padi found in Malacca are Padi Nachin and Padi Siam and line selection work has been in operation with these varieties for some years. Strains of padi Nachin Puteh, Siam, Radin, Siak, and several varieties derived from the Titi Serong Experiment Station are under test of the Station, some of which have given most promising results.

Manurial experiments have been in operation for six years. In the season under review the crops were heavy in all plots, probably because irrigation was perfected and rat damage minimised. The results to date are inconclusive, but there appear to be indications that slow-acting phosphates are beneficial. Manurial experiments included comparisons of the different methods of application.

Cultivation experiments were continued but no significant results have yet been obtained.

Talang Padi Test Station, Kuala Kangsar.

This area of 25 acres has been utilised for the past six years for comparing the effects of elementary manures on the growth and yields and also for testing various types of padi. The manurial experiments have been in progress for six years. As in Malacca, no definite results have yet been obtained from this work. Six varieties of padi were tested in the past season and gave satisfactory yields.

Other padi test stations are Pekan Darat, Province Wellesley; Bukit Merah, Butterworth; Dong Padi Test Station, Pahang; Temerloh Padi Test Station, Pahang; Pekan Wet Padi Test Station, Pahang; and Jelebu Demonstration Plot. At these stations, work was principally concerned with the introduction of strains of padi suitable to the particular conditions of the district; manurial and cultural work and demonstrations.

Manuring Experiments—General.

Regarding the manurial experiments of padi, the very small response over a number of years at Malacca and the not very great response at Talang are most interesting in view of the results of similar work in other countries where increases up to 100% are claimed. In some countries, large increases have been obtained, but on very poor initial yields, whereas in this country, both experimental stations are capable of good yields without the aid of manures. This would indicate that our rice soils, possibly because of their heavier texture, supply of themselves better conditions of growth to meet the plants' requirements than do those of other countries.

It also indicates that one or more limiting factors, untouched by our manuring, are in play. Such factors might include aeration, bacteria, fungal or algal flora, absence of some of the elements—such as iron or magnesium—in available form, or water supply. Further, it might indicate that our manures have been applied at too late a stage in the development of the plant.

In Java, the richer and more efficiently irrigated padi fields which normally produce good crops shew but small response to manuring, whereas poor soils or soils liable to variations in water supply or which suffer from drought have been found to respond to manuring. To some extent the same observations have proved true in Malaya, where crops treated with phosphates mature early and show more resistance to drought than do untreated crops.

In the light of past experience, the Departmental Manurial Committee has recently drafted a new scheme for manurial experiments of padi which is designed to give accurate and statistically significant results. The lay-out of these experiments will be standardised as far as may be compatible with local conditions. Local methods of cultivation will be followed and precautions taken to reduce the experimental error to a minimum.

THE THIRD IMPERIAL ENTOMOLOGICAL CONFERENCE.

London, June, 1930*.

The Third Imperial Entomological Conference was held in London under the auspices of the Imperial Institute of Entomology (formerly titled the Imperial Bureau of Entomology) on June 15-27 of this year. The meetings were held at 41 Queen's Gate, the Headquarters of the Entomological Society of London. About 40 delegates, representing twenty-four different states of the British Empire, attended in an official capacity†. Lord Buxton, the Chairman of the Managing Committee of the Institute, who was unavoidably absent, was represented by Sir Sidney Harmer at the opening meeting.

Mr. A. Gibson, Dominion Entomologist of Canada, showed a remarkable film representing the various phases of the mass production work and the behaviour of the principal parasites of the European Corn Borer as carried on in the laboratory at Chatham, Ontario.

An interesting discussion took place concerning tsetse fly control. Mr. C. F. M. Swynnerton, whose work in areas infested by tsetse is well known, gave a detailed account of the work in Tanganyika, where the practice of grass burning, carried out under skilled direction and combined with the breaking up of the infested zones into areas of a size convenient for burning, has given excellent results. A very important phase of this work has consisted in the production of live fences or hedges designed to prevent the passage of game and produced by the planting of cuttings or live poles of certain species of indigenous trees which are used by the natives to fence their villages. Other important developments in this work are the use of moving baits smeared with tangle foot for the capture of individual flies and the introduction of the aeroplane for scouting work. The subject of game preservation was included in this discussion.

Mr. B. P. Uvarov, of the Imperial Institute of Entomology, one of the foremost living authorities on locusts, opened a discussion on the subject of locusts. Unanimous agreement was expressed as to the necessity for further investigations on the permanent breeding grounds of the migratory locusts and the underlying causes of the phenomenon of migration.

Among other subjects discussed were the organisation of entomological departments, entomological work among backward races, the control of insects by cultural methods, particularly against sucking insects, and on orchard pests in various parts of the world.

* Abstract of a Résumé of the Proceedings of the Third Entomological Conference, June, 1930 by Dr. W. R. Thompson, Assistant Director, Imperial Institute of Entomology and Superintendent, Farnham House Laboratory; published in *Nature*, July 26, 1930.

† Mr. G. E. Mann, Agricultural Instructor was the delegate representing Malaya.

The delegates visited the University of Cambridge and were shown the work conducted by the Department of Entomology and the important investigations on virus diseases of plants. They also visited Messrs. Chivers' Fruit Farm; the Rothamsted Experimental Station and Pathological Laboratory of the Ministry of Agriculture at Harpenden and the Parasite Laboratory at Farnham Royal, Bucks.

A day was devoted to the subject of biological control which is now of especial interest owing to the fact that since the previous Conference, the Imperial Institute of Entomology has founded—with the aid of a grant from the Empire Marketing Board—its laboratory at Farnham Royal as an Imperial centre for work on biological control of insect and plant pests. At the morning meeting, the biological control of insects was considered. It was opened by Mr. A. Gibson, who gave a detailed account of the work in progress on these lines in the Dominion of Canada. In the discussion that followed, many points were brought up concerning the practice of biological control of insect pests in various parts of the world, and general satisfaction was expressed by all the delegates in regard to the initiative which Sir Guy Marshall, Director of the Imperial Institute of Entomology, had taken in the creation of a special institution for work of this type within the Empire. The afternoon meeting was devoted to the subject of control of weeds by insects. Dr. Miller, of the Cawthron Institute of New Zealand, who opened the discussion, gave an account of the work which is being carried on in New Zealand in collaboration with the Imperial Institute of Entomology at Farnham Royal on the biological control of some of the most important weeds of New Zealand, including particularly blackberry, gorse, ragwort, and bracken. He was followed by Dr. A. Nicholson, deputy chief of the Entomological Division of the Commonwealth Council for Scientific and Industrial Research of Australia, who described the successful experiments carried on by the Commonwealth Prickly Pear Board against the various species of prickly pear in Australia. He showed that the initial successes obtained in this work have now been very greatly extended, and that large areas formerly rendered uninhabitable and useless for agricultural purposes by the invasion of the prickly pear have now been freed completely from this pest and are being brought under cultivation.

An official dinner was given to the delegates at Lancaster House, St. James's, by His Majesty's Government under the Chairmanship of Lord Passfield, Secretary of State for the Colonies.

Reviews.

Progress of Co-operation in Malaya.

Two Annual Reports* signed by Mr. A. Cavendish, Director of Co-operation, Federated Malay States and Straits Settlements not only give an account of the work of the Department during the year 1928-1929, but enable the reader to envisage the progress of the movement in Malaya since its inception. The Federated Malay States Department was founded in 1922, the organisation being extended to the Straits Settlements three years later. In addition, there exist Societies in the Unfederated States of Kedah and Perlis that, although not being under the Department, look continually to that organisation for advice and guidance.

Progress during the first few years of the adoption of this policy of co-operation might perhaps be considered slow by those who do not realise the many initial difficulties to be surmounted. The Director has rightly adopted a cautious policy because, no doubt, he realised that local experience was invaluable, and it is therefore unwise to launch a large number of societies without appreciating the possible difficulties that may be encountered. Perhaps an even more important reason for caution is the paramount necessity of educating the masses in the principles of co-operation. In this latter matter, the Department has carried out considerable work, thus paving the way for a more general appreciation of the benefits of co-operation and a consequent rapid extension of the movement.

The four main lines of progress in the establishment of co-operation in Malaya have been Rural Credit Societies, Thrift and Loan Societies, Indian Estate Labourers Co-operative Societies, and Co-operative Rubber Factories.

Rural Credit Societies.—Seventy-nine Societies are now in existence in the Federated Malay States with a membership of 2,538 and a working capital of $135,609. Fourteen such Societies are established in the Straits Settlements with a membership of 461 and a capital of $10,575. This branch of the work of the Department made no rapid strides during the year. It is pointed out that not only had disloyal members to be weeded out, but that the wasteful customs and habits, deep rooted in the usage of centuries, cannot be eradicated in a day and the process of rural regeneration must necessarily be slow.

Thrift and Loan Societies.—These Societies all show signs of vigour and healthy activity, and continuous and steady progress has been made. The Director, however, points out that the need for the education of committees and members in co-operative practice and principles is still very real and ever present. The present strength of this movement in Malaya is as follows:—

* Federated Malay States Annual Report on the Working of Co-operative Societies for the Financial Year ending 30th June, 1929. *F.M.S. Government Press*, 1930; and Straits Settlements Annual Report on the Co-operative Societies for the year 1928-1929. *Government Printing Office, Singapore, 1930.*

F.M.S. 26 societies, 14,120 members, $2,278,795 working capital
S.S. 15 societies, 5,472 members, $ 389,244 working capital

Indian Estate Labourers' Co-operative Societies.—This is a more recent extension of the co-operative movement in the Federated Malay States and one in which substantial progress has been made. Twenty-one new societies were registered. On 30th June, 1929, 33 societies existed. Membership rose from 2,330 to 7,104. Paid-up share capital increased from $22,720 to $74,128 and the working capital amounted to $75,888.

Co-operative Rubber Factories.—An account of the formation of these societies was given in some detail in *The Malayan Agricultural Journal*, April, 1930, so that re-iteration in this place is unnecessary. We await a review of the result of the year's work of the first factory opened with considerable interest.

Co-operation began in this country about eight years ago. Since that time 190 societies comprising 37,500 members have acquired a paid up capital of over $3 millions, and granted loans of over $9 millions, of which $7½ millions have been repaid. Their cash and investments stand at about $2 millions, while their losses are infinitesimal. As will be seen from the foregoing, the bulk of this financial prosperity of the Societies relates to Thrift and Loan Societies which have made very steady progress. The work of the Rural Credit Societies has been much slower and uncertain, but one must not on this account deny the infinite possibilities of further organisation in this direction.

D. H. G.

An Historical Note on *Tirathaba rufivena* Walk. (The Greater Coconut Spike Moth) and Its Three Parasites in Malaya.

BY

G. H. CORBETT

and

Preliminary Observations on *Sogata* spp., Pests of Padi

BY

N. C. E. MILLER AND H. T. PAGDEN.

Special Bulletin, Scientific Series No. 3, Department of Agriculture, S.S. and F.M.S. Price 50 cents, (Straits Settlements Currency).

The Author of the first of these two papers gives the history of the work of identification of *Tirathaba rufivena* Walk. in Malaya and other countries. In addition, an account is given of the three known parasites of this pest; viz. *Nemeritis palmaris* Wilk., *Apanteles tirathabae* Wilk., and *Erycia basifulva* Bezzi, with observations on the incidence, method of attack, the chances of successfully introducing the parasites to other countries, and the comparative utility of each in the control of the pest. A bibliography of literature cited completes the historical survey.

The reader will better appreciate from this account the efforts that are being made successfully to use biological control methods and the amount of liaison between workers in different countries towards this end.

In the second paper, Messrs. Miller and Pagden describe the incidence, life history and control of *Sogata* spp., pests of padi. Outbreaks occur from time to time and occasion considerable damage to padi. Study of this pest is rendered difficult as the attacks appear and disappear with suddenness. The writers are of opinion that the degree of humidity is the determining factor of these outbreaks and advocate for their control the running off of the water from the attacked areas where this practice is possible.

D. H. G.

Investigations on Panama Disease in Malaya

BY

F. S. WARD.

Special Bulletin, Scientific Series No. 2. Department of Agriculture, S.S and F.M.S. 26 pp. 4 plates; price $1 (Straits Currency) Government Printing Office, Kuala Lumpur.

The first conclusive evidence of the presence of Panama disease in Malaya was obtained in 1927 when *Fusarium cubense* was isolated from wilted Pisang Restali in Johore. As a result of the further investigations described in this paper the author has found that the disease may occur in this country in one of two forms, which he differentiates as acute and chronic. The acute form, which tends to develop in neglected cultivations and is usually associated with plants approaching maturity, rapidly proves fatal. On the other hand, the progress of the disease in the chronic form is slow. The affected plants become stunted, but may eventually produce fruit bunches; the development of these is, however, much delayed, and the fruits, which are few in number, often fail to ripen.

In confirmation of experience elsewhere the author finds that the incidence of the disease is heaviest during or just following the rainy season, particularly in areas which are inadequately drained.

Experiments conducted with five physiologically distinct strains of *Fusarium cubense* have shown that a negative correlation exists between growth rate and temperature. This observation is of peculiar interest in view of the opinion held by some that the failure of Panama disease to develop on the irrigated lands in Jamaica and Colombia is due to the high soil temperatures prevailing under such conditions.

Extensive inoculation experiments with three strains of *Fusarium cubense* and with a bacterium resembling *Pseudmonas musae* are described. Pisang Rajah, Pisang Serendah (*M. Cavendishii*) and Pisang Mas appear to be immune or highly resistant to Panama disease, as also are the indigenous species of Musa (*M. malaccensis* and *M. violescens*). Pisang Embun (which is thought to be the same as the Gros Michel of the West Indies) Pisang Restali and Pisang Talon have proved susceptible.

The morphological and physiological characteristics of four Malayan strains of *Fusarium cubense* are described in detail.

R.A.A.

AGRICULTURAL SHOW, TEMERLOH.

A very well attended Show was held at Temerloh on Saturday, the 27th September, 1930. Exhibits were numerous, more especially in the cereals section which comprised about 1200 exhibits of padi and rice and the largest collection of maize cobs seen at any Show for some time. A factor which detracted somewhat from the value of a portion of the padi exhibits was that local padi growers did not appear to understand that exhibits entered for a class intended for one variety of padi only should be confined to that variety. The number of maize exhibits, which was well over 100, bore eloquent testimony to the increasing popularity and importance, since the 1926 floods, of maize as a supplementary food crop in the District.

The section for the produce of school gardens contained some good exhibits of oranges, bananas and yams; a fairly large collection of good clean samples of kapok fibre; numerous specimens of coconut oil; and of sugar and rope from the sugar palm. In the Arts and Crafts Section, baskets and mats were most in evidence. A number of village fowls and fairly numerous exhibits of eggs were conspicuous features of the Livestock Section.

The Forest Department displayed a collection of timber samples and of rotans. The Rubber Research Institute staged an exhibit of rubber diseases and of bud grafting. Periodic demonstrations of the actual operation of grafting were also given by an experienced Malay Officer of the Institute and attracted much attention. The Department of Agriculture displayed educational exhibits dealing with the advantages of pedigree strains of padi and with insect pests of that crop, rat destruction, faults in copra production, marasmius disease of coconut petioles, specimens of tea from the Government Plantations at Serdang and Cameron's Highlands; and vernacular publications for distribution. The exhibits connected with padi proved so popular that two Malay Officers of the Department were kept fully occupied in explaining them and answering questions.

The keen interest displayed by Malay visitors and competitors both in the educational exhibits and the competitive sections gave evidence of the value of the Show as a means of improving agricultural practice in the District.

ENTOMOLOGICAL NOTES.

Third Quarter, 1930.

Oil-Palm.

The first occurrence of a caterpillar damaging the fruits of the oil-palm in Malaya has recently been recorded. Two bunches, containing 1213 developed fruits, showed 368 fruits with damaged pericarp, of which 172 contained no kernel. In some cases, the kernel had been destroyed by the caterpillar, but in the majority it appeared to have been broken down by bacteria penetrating the hard shell. Fruits which have been completely ringed at the base by the caterpillar have been observed.

Observations will be continued to ascertain the economic importance of this insect and also to confirm the statement that only isolated bunches are damaged. At the time of writing, this caterpillar has only been reported from one estate which indicates either that it is not widely distributed or that injured fruits have not been observed elsewhere.

The full-grown caterpillar (v. plate below) is about 25 mm. in length, slightly hairy, dark with a reddish brown coloured head. The moth has not yet been obtained.

Managers of estates are asked to submit bunches of fruits in preference to fruits for examination in order to ascertain if this insect is generally present throughout Malaya.

" White ants " have again been troublesome on some oil palm properties by working up through the trunk and finally destroying the bud.

Attention is drawn to the fact that after the operation of pruning, sufficient care is not always taken in disinfecting the cut-ends of petioles. This procedure is necessary essentially to prevent the red-stripe weevil (*Rhynchophorus schach* Oliv.) laying its eggs on exposed surfaces.

Coffee.

The beetle berry borer—*Cryphalus hampei* Ferr.—has been reported from other coffee areas during the month. This is a most important enemy as it may reduce the yield of coffee to a negligible quantity. In severe attacks, the institution of a " dead " season when no coffee berries are allowed to mature is

essential for its control. It is advisable that introductions of berries should not be made on estates at present free of this pest, and that where berries have been imported, they should be carefully examined to see if they contain the beetle. All importations should be thoroughly inspected and should not be sown if the presence of this beetle is observed.

Tuba.

A Chrysomelid beetle, tentatively identified as *Neolepta biplagiata* Jacoby, formed the subject of an enquiry as it has been responsible for considerable damage to the leaves of Derris. The eggs, larvae and pupae are found in the soil. The beetle is about three-sixteenths of an inch in length, head dark brown, thorax brownish yellow and the wing covers pale brownish with a irregular, broad dark brown band across the front portion.

The beetle readily succumbs to a spray consisting of pyrethum powder 1.67 lbs., soap 1.67 lbs., petroleum 0.8 gallons and water 40 gallons. The above quantities are considered to be sufficient for one acre. The total cost of application, including materials and wages, amounts to $1.70—$2.00 per acre. The spray would be reduced in cost and would possibly prove equally satisfactory if petroleum were omitted.

Padi.

The investigation on the control of "borers" by the parasite, *Trichogramma nanum* Zehnt., has been continued. Two consignments of this parasite have been sent to Ceylon in the hope that it will eventually prove of value in controlling the Tea Tortrix.

Reports of the caterpillars of *Spodoptera mauritia* Boisd. damaging padi in the field have been received from most States in Malaya. This moth has never been reported as causing extensive damage to padi in the field. It generally confines its attention to nursery padi. The unusually dry weather is thought to have been conducive to increasing its range to padi in the field. Hand collecting of the caterpillars and turning ducks, which readily devour the caterpillars, on the padi fields, were practised and proved successful. Recent information indicates that the damaged padi will suffer no permanent injury.

Coconuts.

Outbreaks of *Artona catoxantha* Hamps. have not been recorded. It has been suggested that since smoke has been thought to be a possible cause of outbreaks of this moth, incinerators should be removed from the immediate vicinity of coconuts or that coconut palms in the neighbourhood of incinerators should be cut out. Whilst some evidence seems to exist associating smoke with

outbreaks, the removal of one or the destruction of the other is not considered to be advisable. Until more definite evidence is available, however, it might be advisable to construct incinerators as far removed as possible from coconut palms.

Miscellaneous.

" Tuba " used at the rate of 1 lb. to 10 gallons of water is a good insecticide for general use in the garden, as plants regularly sprayed will be kept comparatively free from mealy bugs, thrips, aphids and similar insects. The flowering of Vanda orchids is frequently disappointing. This is due entirely to the buds being killed by the incessant sucking of the sap by thrips. Maidenhair ferns and similar plants are often dwarfed in growth by mealy bugs; a tuba spray would be found very satisfactory in controlling them.

Borax is often used for cockroaches but sodium fluoride mixed with an equal weight of flour is more effective.

General.

Mr. C. P. Clausen, Entomologist, Bureau of Entomology, U.S.A., who has been stationed in the Far East for about a year spending most of his time in Malaya, returned to America in August. He has been engaged sending importations of parasites for the control of the white fly—*Aleurocanthus woglumi*—of citrus to Cuba.

Mr. C. E. Pemberton, Entomologist, Sugar Growers' Association, Hawaii, arrived in Malaya in August for the purpose of introducing parasites of sugar cane insects into Hawaii.

The importance of the control of pests by parasites is emphasised by the departure and arrival of these two Entomologists.

FROM THE DISTRICTS.

The Weather.

In Kedah and Singapore Island an adequate rainfall was well distributed; in the northern half of Malacca heavy showers fell, but Jasin District continued to suffer from drought until the last few days of the month. Most of the country, however, experienced first a wet period of about ten or eleven days duration, then two weeks of dry weather, and finally a few wet days at the close of the month.

Remarks on Crops.

Rubber.—The decline in the price of rubber continued; smoked sheet from small holdings sold for $10 to $16 and unsmoked sheet for $9 to $12 per picul. No definite reports of the closing down of estates have been received but in all parts of the country the number of untapped small holdings has increased considerably. In Negri Sembilan alone it is estimated that 2000 acres of such holdings are now untapped, while tapping is continued on a number of others only because they are the only source of livelihood either for the owners or their relatives. A certain proportion of the increase in the number of untapped holdings is due to the fact that their owners have been occupied with padi planting operations.

The continued movement of tappers is resulting in the further spread of Mouldy Rot Disease and is likely to cause an even wider and more rapid distribution of the fungus when the favourable damp conditions attending the rainy season become generally prevalent. A second "wintering" of rubber trees occurred in many localities during the month induced by the previous spell of drought. From two estates in Malacca reports were received of the reappearance of secondary leaf fall caused by *Oidium Hevea* which had previously attacked young leaves in March after the first "wintering". This disease was also found on an estate in Province Wellesley in which District its presence had not previously been definitely confirmed.

Padi.—Improved weather conditions enabled good progress to be made with planting operations in those districts where it was not already completed; the general prospect for the season's crop consequently has improved. Along the Perak river the land was still dry, but in some localities planting was done by dibbling the plants into the soil in the hope that rain would fall in time to enable them to make good growth. In view of the possible failure of the wet padi crop in the river areas of Pahang West, it has been supplemented to a certain extent by different forms of dry padi cultivation.

There was an outbreak of army worms *Spodoptera mauritia* on young planted padi in a few localities in Malacca, but the pests disappeared entirely from all

the areas in which attacks occurred during the month of August. Further outbreaks of the Pentatomid bug *Scotinophara coarctata*, M. Kutu Bruang or Bena Kura have occurred in situations where padi has suffered from drought. All three species of stem borers would also appear to be generally distributed and have occasioned considerable loss in some places. In Kedah a satisfactory method was found for trapping crabs which had destroyed whole fields of newly planted padi in one area.

Food Crops.—The Malays living along the Pahang river have planted up a very large area with maize, tapioca, beans and other food crops in addition to the areas of hill padi which have been or are being planted. The river banks, islands, State Land on Temporary Occupation Licence and land already given out for rubber cultivation have been utilised for this purpose. Some excellent crops of maize have already been harvested. This alternative food supply should help to reduce the danger of food shortage presented by the uncertainty of the wet padi crop.

In Kedah a crop of maize planted with hill padi was reaped from an area of 71 acres in one locality, while in Province Wellesley good crops of tapioca, sugar cane and vegetables were obtained.

In Negri Sembilan a number of small areas of vegetables have been planted recently chiefly for consumption by their owners. Efforts are being made to get more maize, tapioca, yams and sweet potatoes planted, but weather conditions recently have not been favourable.

Fruit.—An early season was being experienced in the coastal districts of Selangor where durians, mangosteens and rambutans were available in small quantities. In other districts of this State there was a general shortage. The supply in the Kuala Lumpur market came largely from Malacca and consisted mainly of langsat, duku and rambai. The fruit seasons this year appear to to be very irregular in several parts of the country.

Large numbers of water melons have been taken from the Dindings for sale on the Penang markets.

Tobacco.—In the Baling District of Kedah a small tobacco industry has been established. The area under cultivation is 220 acres. The produce is all sold locally and used in the manufacture of cigars. The present price paid for dried leaves is $20 to $25 per pikul.

Great interest is being taken in the effort of this Department to establish tobacco as a catch crop or rotation crop in Chinese market gardens in Province Wellesley and there have been many applications for seed. The nursery beds sown at Permatang Pauh and Sungei Rambai were showing good growth and doing well.

Tea.— There has been a further drop in prices for local Chinese tea in Selangor, the best quality now realising 65 cents per kati. On small holdings some interest has been taken in soil conservation as a result of departmental leaflets recently issued and of lectures and advice given by the Chinese Sub-

Inspector of Agriculture. Silt pitting and the planting of cover crops is now being undertaken by some cultivators at Sungei Balak.

Tuba.—An estate in Pahang now has 1050 acres planted with this and other crops from which insecticides can be prepared.

Cloves and Nutmegs.—In the Settlement of Penang nutmegs are in bearing but cloves are not yet flowering. The clove gardens are receiving more than usual attention.

Notes on Demonstration Stations and Padi Test Plots.

Kedah Rice Experiment Station.—Good progress was made with the preparation of the land for planting in October. The nurseries required constant attention owing to the attacks of various pests.

Pulau Gadong Padi Experiment Station, Malacca.—An additional area of $3\frac{1}{2}$ acres of land with road frontage has been purchased and added to this Station. The addition of this land has greatly improved the appearance of the Station. It has been used this season for preliminary experiments in mechanical cultivation.

Bukit Merak Padi Test Plot, Province Wellesley.—Heavy rain at the beginning of the month enabled good progress to be made with the work of preparing this land for planting.

In Selangor, insect pests, mainly stem borers, have caused damage at the Kuang plot, while parts of the Kajang plot have suffered from lack of water. In Pahang growth on the Temerloh plot has also been affected by drought. On the Alor Gajah plot in Malacca the transplanted padi was severely attacked by army worms, *Spodoptera mauritia,* which were controlled by hand picking and by spraying with tuba root solution.

Kuala Lipis Demonstration Station.—One plot of ground nuts was harvested and four varieties of sweet potatoes were planted. A system of bunds was constructed to conserve the soil.

Sungei Udang Demonstration Station, Malacca.—The work of felling jungle and clearing 16 acres of this site was commenced.

Pineapple Experiment Station, Singapore.—Preliminary work in connection with the establishment of this Station has been commenced on the site at Lim Choo Kang. Details and lay-out of four sets of experiments on manuring, cultivation, rotation and green dressings, and planting distances have been arranged. Plans for buildings have been prepared and a road survey has been made. Erection of the buildings is expected to commence in the near future.

Plant Distribution.

Among the usual distributions of planting material during the month, mention may be made of the supply of considerable quantities of seed of a good variety of Australian maize to school gardens and small-holders in Province Wellesley, and of seed of four varieties of maize from the Government Experimental Plantation, Serdang to the Singapore Cold Storage Dairy Farm for trial

as fodder. Other distributions included planting material of yams, sweet potato, tapioca, maize, and various vegetables to school gardens and small-holders in different parts of the country, together with some mixed fruit seedlings from Serdang for the Jurong District of Singapore.

Rats.

In Province Wellesley 122,731 rat tails were purchased and 51,600 poison balls were distributed. In Krian rewards were paid for 259,792 tails, and 51,479 poison balls were supplied. In Selangor a small meat mincing machine proved very satisfactory in the preparation of 1 1/5 tons of poison balls of which 1472 lbs. have already been distributed for use in padi fields. Where used, the balls have been readily taken by rats. Elsewhere there has been a good demand for rat traps and supplies of poison at cost price.

DEPARTMENTAL NOTES.

Visit of H.E. The Governor.

His Excellency, Sir Cecil Clementi, K.C.M.G., Governor and Commander-in-Chief of the Straits Settlements and High Commissioner of the Malay States, visited the Government Experimental Plantation, Serdang, Selangor on 20th September, 1930.

Visit of H.R.H. Prince Purachatra of Siam.

H.R.H. Prince Purachatra, Minister of Commerce and Communications, Siam, visited the headquarters of the Department of Agriculture at Kuala Lumpur on 13th September, 1930.

The Director of Agriculture visits Malacca.

The Director of Agriculture, as Chairman of the Committee for the Extension of the Cultivation of Rice in Malaya, accompanied the Committee on a visit to Malacca on 1st and 2nd September, 1930.

Delegation of Rice-Production Committee visit the Northern Rice Areas.

The Director of Agriculture, the Hon'ble Dato Rembau, Mr. C. W. Maxwell and Dr. H. W. Jack who form the visiting delegation of the Committee for the Extension of the Cultivation of Rice, proceeded on the 21st September, 1930, on a tour of the northern rice-producing areas of Malaya. The Delegation visited the rice-growing areas of Krian in Perak, Province Wellesley, Kedah, Perlis and Siam. The tour was completed on October 6th.

Demonstrations to Chinese at the Government Experimental Plantation, Serdang.

A party of Chinese agriculturists from Kepong, Selangor, attended a demonstration at the Experimental Station, Serdang on August 5th, 1930. A somewhat similar demonstration was given on September 9th. to a party of Chinese agriculturists from various districts around Kuala Lumpur. As usual, these demonstrations were much appreciated, considerable interest being maintained throughout the tours.

Departmental and Inter-Departmental Agricultural Conference, 1930.

Arrangements are in hand for the holding of a Conference of Officers of the Department of Agriculture in Kuala Lumpur from October 27th. to November 1st. 1930. It is hoped that officers of the Rubber Research Institute of Malaya,

the Co-operative Department and the Veterinary Department will also attend the Conference.

It is expected that the Conference will be opened at 10 a.m. on October 27th. by the Hon'ble the Chief Secretary to Government, to be followed by an address by the Director of Agriculture. The public are invited to the opening, but subsequent proceedings will be private. At the conclusion of the Conference, a statement of the proceedings will be made public, and it is also hoped to publish in *The Malayan Agricultural Journal* certain of the papers read at the Conference.

Vernacular Publications.

Two leaflets in the Vernacular have recently been issued by the Department. "Soil Erosion: what it is and how it can be guarded against" has been published —with illustrations—in both Malay and Chinese. A total of nearly 5,000 copies have been distributed throughout Malaya. The second leaflet, prepared by the Rubber Research Institute of Malaya on "Notes on the Care of Rubber Trees, Tapping, Preparation of Rubber &c. for Small-holders," has also been published in Malay and Chinese; 6,000 copies of which will be similarly distributed throughout the country. These articles will also be reprinted in the quarterly journals of the Department in Malay and Chinese, of which 5,000 copies of each are published. In this way, very wide circulation of information on these two important subjects will be achieved.

Leave.

Major C. D. V. Georgi, O.B.E., Acting Agricultural Chemist, has been granted 5 days full pay leave from 13th. September, 1930 to be followed by 3 months 25 days half-pay leave from 18th. September, 1930 on the ground of ill-health.

Mr. V. R. Greenstreet, Assistant Agricultural Chemist, has been granted 9 months 12 days full-pay leave from 12th. September, 1930 to be followed by 2 months 15 days study leave on full pay from 24th. June, 1931.

MARKET PRICES.

September, 1930.

Rubber.—The market price of rubber continued to decline steadily throughout the month. The highest price in Singapore was 15¼ cents on September 1st; the lowest on September 30th, when it stood at 11½ cents per lb. The highest price in London was 4¾d. on September 1st, while the lowest on record was on September 30th when it reached 3¾d. The average price in Singapore for month was 12.8 cents., in London 4.09d, compared with 15.55 cents. and 4.84d. respectively in August.

Copra.—The average Singapore prices of copra for September were; sundried $6.57; mixed $6.39; compared with $7.11 and $6.89 per picul in August. Copra cake averaged $2.13 per picul in September. While prices continued to decline, the market has remained active, and supplies have shewn no signs of falling off.

Gambier.—Singapore average prices for September were: Block $9.70, Cube $14.35. The previous month's averages were $9.40 and $14.34 per picul respectively. Latest information is to the effect that the demand is poor and prices tend to decline.

Nutmegs.—Average prices in Singapore for September were: 110 per lb. $25; 80 per lb. $29.20 per picul compared with $25.62 and $30 respectively in August.

Mace.—Siouw averaged $63.80 per picul; Amboina $39.90 per picul on the Singapore market. The corresponding prices in August were $62.70 and $33.17.

Pepper.—Singapore average prices were: Black $21.45; White, Rio and Sarawak $30.50; Muntok, white, $31.40 per picul. In August the corresponding average prices were $22.09, $30.81, $30.17. The market has firmed following the London advance and an improved demand from Eastern Ports.

Sago.—Singapore average prices for September were:—Flake, small, fair, $6.22½ per picul compared with $6.45½ in August; Flour, $2.96 per picul compared with $3.04 in August. Supplies continue to be full and prices tend to decline.

Tapioca.—September average prices in Singapore were:—Flake, small, fair, $4.13; Pearl, seed, $5.42½; Pearl, medium, $5.75. Corresponding prices in August were $3.86, $5.50, $5.75 per picul. Moderate transactions are reported, prices throughout the month being steadier.

Pineapples.—Average Singapore prices in September: 1½ lb. cubes $3.80; 1½ lb. sliced, flat, $3.68; 1½ lb. sliced, tall, $4.23, compared with $3.60, 3.60, and $4.18 per case in August. The demand is negligible and very little business is reported.

The above market prices are based on the daily cabled London quotations and the Singapore quotations for rubber; on the Singapore Chamber of Commerce Market Reports from 30th August to 27th September and on other local sources of information.

1 picul = 133⅓ lbs.

The dollar is fixed at two shillings and four pence.

FEDERATED MALAY STATES.

RUBBER CROP AND TAPPING STATISTICS FOR 1929 OF ESTATES OF 100 ACRES OR OVER.

State.	Total Area planted with mature tappable rubber.	Average area tapped. (A)	Average area rested.	Percentage of tappable area rested.	Average number of days upon which tapping was done.	Crop harvested from tapped area. (Col. A.)	Average yield per tapped acre, per year.	Notes.
	Acres.	Acres.	Acres.			Pounds.	Pounds.	
Perak ...	231,029	212,100	18,929	8.19	348	102,117,120	481.64	
Selangor ...	278,904	240,300	38,604	13.84	350	120,704,640	502.30	
Negri Sembilan	204,547	188,310	16,237	7.94	349	88,533,760	470.15	
Pahang ...	29,417	25,710	3,707	12.60	347	12,499,200	486.16	
Total	743,897	666,420	77,477	10.64	...	323,854,720	485.06*	

*The average yield in 1927 was 420 lbs. and that in 1928 was 436 lbs.

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STRAITS SETTLEMENTS.

RUBBER CROP AND TAPPING STATISTICS FOR 1929 OF ESTATES OF 100 ACRES OR OVER.

Territory.	Total area planted with mature tappable rubber.	Average area tapped. (A)	Average area rested.	Percentage of tappable area rested	Average number of days upon which tapping was done.	Crop harvested from tapped area. (Col. A.)	Average yield per tapped acre, per year.	Notes.
	Acres.	Acres.	Acres.			Pounds.	Pounds.	
Malacca	100,149	86,450	13,699	13.68	324	36,321,600	420.15	
Pro. Wellesley -	41,205	35,812	5,393	13.08	336	14,300,160	399.31	
Dindings -	5,676	5,360	316	5.57	348	2,636,480	491.88	
Total 12 Months	147,030	127,622	19,408	13.20	...	53,258,240	417.31*	† Approx: rate per Year.
Penang ‡ -	1,374	1,100	274	19.94	346	181,440	164.95 †	329.90
Singapore ‡ -	29,637	24,200	5,437	18.31	340	3,577,280	147.82 †	298.64
Total 6 Months	31,011	25,300	5,711	18.42	...	3,758,720	148.57	

‡ **Notes**:—The figures for the Islands of Penang and Singapore are for the **six** months ending December, 1929. For periods earlier than 1st July, 1929 the information is not available.

*The average yield in 1927 was 350 lbs. and that in 1927 376 lbs.

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MALAYA RUBBER STATISTICS.

STOCKS OF RUBBER, INCLUDING LATEX, CONCENTRATED LATEX AND REVERTEX HELD BY DEALERS AND ESTATES OF 100 ACRES AND OVER, THE DECLARED PRODUCTION OF THE SAME ESTATES, IMPORTS AND EXPORTS, AND THE ESTIMATED PRODUCTION OF ESTATES OF LESS THAN 100 ACRES, FOR THE MONTH OF AUGUST 1930, IN DRY TONS.

Territory	Stocks at beginning of month			Production by estates of 100 acres and over		Production by estates of less than 100 acre (estimated)		Imports				Exports (including re-exports)				Stocks at end of month		
								during the month		during the year 1930		during the month		during the year 1930				
	Ports	Dealers	Estates of 100 acres and over	during the month	during the year 1930	during the month	during the year 1930	Foreign	From Malay States	Foreign	From Malay States	Foreign	Local	Foreign	Local	Dealers	Estates of 100 acres and over	Ports
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
MALAY STATES																		
Federated Malay States	...	9,831	15,320	13,955	88,432	10,238	74,869	Nil	5	Nil	47	17,539	6,124	121536	42,842	10,302	15,382	...
Johore	...	2,043	4,964	4,519	27,290	4,454	32,003	Nil	2	Nil	14	1,431	7,225	8,072	51,824	2,069	5,297	...
Kedah	...	418	2,241	2,404	15,007	1,276	9,995	Nil	Nil	30	Nil	873	2,604	5,620	19,283	475	2,387	...
Perlis	..	7	10	10	67	8	109	Nil	Nil	Nil	Nil	Nil	20	Nil	193	7	8	...
Kelantan	...	144	158	316	1,922	310	3,080	4	Nil	30	Nil	91	589	549	4,590	144	108	...
Trengganu* ...	...	55	50	102	924	51	462	Nil	Nil	Nil	Nil	Nil	153	Nil	1,387	55	50	...
STRAITS SETTLEMENTS																		
Malacca	...	2,328	1,775	1,461	9,318			Nil	2,676	Nil	12,686	4,640		30.387		2,461	1,951	...
Province Wellesley	...	121	733	618	3.487	†										145	702	...
Dindings	...	120	172	153	781	5,930	26.871	561	3,834	6,482	26,780	5,884	Nil	44.283	Nil	117	191	...
Penang	1,524	4,869	15	11	82											5,953	14	1,197
Singapore ...	4,474	37,099	376	249	1,804			7,893	10,198	75,223	80,592	20,278		165,822		32,637	340	4,680

ANALYSIS OF COLONY, FEDERATED MALAY STATES AND JOHORE DEALERS' STOCKS AT END OF MONTH, IN DRY TONS.

Class of Rubber	Federated Malay States	Singapore	Penang	Province Wellesley, Dindings and Malacca	Johore	Gross total
(20)	(21)	(22)	(23)	(24)	(25)	(26)
Smoked sheet ...	7,467	16,507	3,660	1,650	900	30,184
Crepe	608	13,798	1,438	711	199	16,754
Unsmoked sheet ...	1,048	2,332	855	362	574	6,746
Scrap and lump ...	1,179				396	
Total all Grades ...	10,302	32,637	5,953	2,723	2,069	53,684

Notes.—1. Stocks on estates of less than 100 acres and stocks in transit on rail, road or local steamer are not ascertained.

2. The production of estates of less than 100 acres is estimated from the formula: Production + Imports + Stocks at beginning of month = Exports + Stocks at end of month; i.e., Column (7) = Columns (13) + (14) + (17) + (18) + (19) — (2) — (3) — (4) — (5) — (9) — (10).

3. Colony Dealers' Stocks are as published in Return I. & E. 6, dated 10 Sept., (S. S. *Gazette* Not. No. 1868), being dry weight as estimated by Dealers themselves.

4. Malay States Dealers' Stocks are reduced by the following fixed ratios: Unsmoked sheet, 15%; Wet Sheet, 25%; Scrap, Lump, etc., 40%.

5. Foreign Imports are as published in Return I. & E. 5, dated September 4, (S.S. *Gazette* Not No. 1815), foreign wet imports being reduced to dry weight by 25 per cent.

6. Foreign exports of each State and Settlement are those published in the Malaya Monthly Trade Return (Appendix II), and are distinct from Ocean-Shipments as published in Return I. and E. 4, dated September 4, *Gazette* Not. No. 1814 Appendix IV to Monthly Trade Return).

*7. Stocks and production in Trengganu are estimated from figures supplied by the Commissioner of Lands.

8. All statements are brought up to date monthly and any inaccuracies that may be disclosed are corrected in the totals; the latest publication, therefore, is always the most reliable.

†9. This hypothetical figure, based on the formula quoted in Note 2, contains whatever errors exist in the Columns comprising it and may therefore be expected to fluctuate from month to month. A truer indication of production will be the monthly average over as long a period, for which figures can be estimated, as possible.

Singapore, September 19, 1930.

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SUMMARY OF PADI REPORTS, FEDERATED MALAY STATES AND STRAITS SETTLEMENTS, FOR THE MONTH OF AUGUST, 1930.

State	District	Acreage of padi land	Acreage planted	Percentage 4 to 3	Gross crop	Crop per acre 6 to 4	Remarks
(1)	(2)	Acres (3)	Acres (4)	(5)	Gantangs (6)	(7)	(8)
Perak	Perak North :						
	Krian	53,250	...	...	...	...	2000 acres planted. Preparation of Land in progress excepting mukims of Selinsing and Gunong Semanggol—10500 acres.
	Larut	8,525	...	...	...	...	Drought still holding up planting. Some of the nurseries sown early have suffered badly.
	Selama	3,450	...	...	...	...	
	Kuala Kangsar	13,997	...	...	...	...	Preparation of land and planting in progress excepting Bruas, Layang2, Bota Lambar Kiri and Kanan—6900 acres—where lack of water is holding up operations.
	Upper Perak	3,739	...	...	...	...	
	Perak South :						
	Six mukims	14,187	...	...	...	...	Planting in progress.
		97,148	...	...	...	...	Transplanting completed.
Pahang	West :						
	Temerloh	12,311	...	...	...	...	Transplanting completed.
	Raub	5,112	...	...	...	...	Transplanting in progress.
	Kuala Lipis	5,576	...	...	...	...	Transplanting completed
	Bentong	783	...	...	...	...	Transplanting completed.
		23,782	...	...	...	...	
Negri Sembilan	Seremban	4,904	...	...	...	...	Transplanting started.
	Kuala Pilah	17,931	...	...	...	...	Transplanting in progress.
	Port Dickson	159	...	...	...	...	Transplanting in progress.
	Jelebu	3,116	...	...	...	...	Transplanting completed.
	Tampin	2,609	...	...	...	...	Transplanting in progress.
	Rembau	7,897	...	...	...	...	Transplanting in progress.
		36,616	...	...	...	...	

SUMMARY OF PADI REPORTS, FEDERATED MALAY STATES AND STRAITS SETTLEMENTS, FOR THE MONTH OF AUGUST, 1930.—(Continued).

State or Settlement	District	Acreage of padi land	Acreage planted	Percentage 4 to 3	Gross crop	Crop per acre 6 to 4	Remarks
		Acres	Acres		Gantangs		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Selangor	Ulu Langat	2,670	...	...	...	...	Transplanting completed except in Beranang where transplanting is in progress.
	Kuala Langat	797	...	...	...	...	Transplanting completed except in Sungei Buloh where transplanting is in progress.
	Ulu Selangor	1,205	...	...	...	...	Transplanting completed.
	Kuala Selangor	18,564	...	...	...	...	Tanjong Karong and Sekenchau—694 acres—abandoned. Preparation of land in progress in other mukims except Jeram where transplanting is in hand. Delay was due to dry weather.
		23,236	...	...	...	...	
Straits Settlements	Malacca, Central	16,473	...	...	...	...	Planting almost completed.
	Alor Gajah	11,136	...	...	...	...	Planting almost completed.
	Jasin	5,756	...	...	...	...	Preparation of land and transplanting commenced.
		33,365	...	...	...	...	
	P. Wellesley, North	18,560	...	...	...	...	Very little progress made owing to lack of water.
	Central	10,539	...	...	...	...	Clearing in progress. Nurseries have been prepared and sown.
	South	4,643	...	...	...	...	Clearing in progress. Few nurseries have been prepared and sown.
		33,748	...	...	...	...	
	Penang	4,000	...	...	...	...	Clearing almost completed.
	Singapore	nil	...	...	...	...	

N.B.—The figures given in the latest return under column 3 may be accepted as more accurate than any given in previous returns.

METEOROLOGICAL SUMMARY, MALAYA. AUGUST, 1930.

Locality	Air Temperature in degrees Fahrenheit							Earth temperature		Rainfall									Bright Sunshine			
	Means of		Mean of A and B	Absolute Extremes				At 1 foot	At 4 feet	Total		Most in a day	Number of days						Total	Daily Mean	Per cent	Length of Day
	A. Max.	B. Min.		Highest Max.	Lowest Min.	Lowest Max.	Highest Min.					Amt.	Precipitation*	Precipitation, 1mm. or more	Thunderstorm	Thunder heard	Fog morning obs.	Gale force 8 or more				
	°F	°F	°F	°F	°F	°F	°F	°F	°F	in.	mm.	in.							hr.	hr.	%	hr.
Railway Hill, Kuala Lumpur, Selangor ...	92.7	71.3	82.0	98	69	88	74	83.3	83.8	6.06	153.9	1.98	16	10	2	11	2		230.50	7.43	61	12.2
Bukit Jeram, Selangor ...	90.1	72.9	81.5	93	69	87	76	86.1	88.3	3.21	81.5	0.99	14	11	2	13	16		246.10	7.94	65	12.2
Sitiawan, Perak ...	90.1	71.8	80.9	95	69	80	75	84.4	84.7	3.22	81.8	0.93	10	8	7	18	2		212.90	6.87	...	...
Kroh, Perak ...	86.7	69.4	78.1	92	66	79	72	81.4	83.1	6.21	157.7	1.09	17	16	...	15	...		193.75	6.25	...	...
Temerloh, Pahang ...	92.2	71.9	82.1	96	68	86	74	86.2	86.6	3.62	91.96	1.06	11	10	3	20	4		250.30	8.07	66	12.3
Kuala Lipis, Pahang ...	90.3	71.2	80.7	93	68	87	75	84.3	84.4	6.17	156.7	1.59	13	11	14	20	15		221.55	7.15	...	...
Kuala Pahang, Pahang ...	87.4	74.6	81.0	90	71	85	78	88.4	87.9	2.18	55.4	0.99	7	5	7	15	...		283.45	9.14	75	12.2
Cameron's Highlands, Rhododendron Hill, Pahang ...	72.3	59.6	65.9	78	58	67	62	...	...	4.54	115.3	0.87	20	16	5	24	3		174.25	5.62	46	12.3
Cameron's Highlands, Tanah Rata	72.8	53.7	63.3	77	48	68	60	69.7	69.6	3.66	92.9	0.68	19	17	5	24	11		173.80	5.61	46	12.3
Fraser's Hill, Pahang ...	74.4	62.0	68.2	78	60	71	65	71.1	71.3	7.73	196.3	1.56	18	15	1	16	22		213.15	6.88	56	12.2
Mount Faber, Singapore ...	89.9	77.3	83.6	92	72	85	80	84.4	85.4	1.80	45.7	0.56	9	6	1	11	...		279.05	9.00	74	12.2
Butterworth, Province Wellesley	88.1	73.8	80.9	92	71	83	77	86.5	85.4	3.77	95.77	1.00	15	12	1	19	1		208.00	6.71	...	...
Bukit China, Malacca ...	85.5	73.2	79.3	88	70	81	76	84.6	85.3	3.95	100.3	1.21	14	11	3	5	...		265.40	8.56	70	12.2
Kluang, Johore ...	89.7	70.5	80.1	93	68	84	75	82.1	82.6	2.98	75.7	1.31	12	9	1	12	5		231.70	7.47	61	12.2
Bukit Lalang, Mersing, Johore...	89.9	72.1	81.0	92	69	88	75	82.8	82.4	1.73	43.95	0.68	7	5	...	18	...	1	280.10	9.04	74	12.2
Alor Star, Kedah ...	88.6	73.8	81.0	92	71	84	77	86.7	86.8	9.34	237.24	4.64	19	12	...	5	...		211.45	6.82	...	...
Kota Bharu, Kelantan ...	89.2	73.5	81.3	92	72	79	77	85.6	85.5	3.03	77.0	0.81	15	10	3	16	...		226.20	7.30	...	...
Kuala Trengganu, Trengganu...	88.5	72.7	80.6	92	69	77	76	83.2	83.9	12.85	326.4	4.93	10	9	2	8	2		242.50	7.82	...	...

Precipitation ·01 inch or more when measurement is in inches ·2mm. or more when measurement is in millimetres.
Compiled from Returns supplied by the Meteorological Branch, Malaya.

Delegates of the Second Inter-Departmental Agricultural Conference, Kuala Lumpur, October 27th to November 1st, 1930.